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A SERIAL STUDY ON OCCLUSION FROM BIRTH TO THREE YEARS

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LONG-RANGE individual studies starting from birth are needed. Piecing together findings of short-range studies permits the imagination to assume an important role at the junction points, and therefore such knowledge cannot give a true picture. From protracted studies (birth to 25 years), important evidence will be found which will aid the progress of orthodontics.

In this study individual impressions of the maxillary and mandibular arches were taken periodically on an unselected group. Besides examining over 1,000 newborn infants in both hospital and private practice, 322 sets of casts were made, and articulated by means of bites[1] and observations. I have two sets to fifteen sets of serial casts from birth to three years of age on forty normal and nine cleft palate children, but some have not as yet a full dentition. This paper is on the normal group, and the cleft palate group will be reported on subsequently. Evidence will be presented from the casts, histories, roentgenograms, and observations on such questions as: Does the anterior space between the gum pads have any relationship to the degree of overbite; to occlusion? Does the type of delivery have any bearing on occlusion? Is thumb-sucking an etiologic factor in malocclusion? How early can irregularities and malocclusions be recognized?[2]

It has been asked, "What practical values can result from such a study?" In this country there are 6,000,000 children[3] in need of orthodontic treatment. The best way to meet this responsibility is by prevention; therefore we must know the underlying etiologic factors. We must first determine the earliest age at which malocclusion begins. If, for example, at 2 years of age we find malocclusion present, then the search for its etiology is confined to this limited time. On the other hand, if at this age the malocclusion is not present, it

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does not follow that the causes are not in operation; it may only mean that it is not manifested at this time and therefore the search spreads over a longer period.

TECHNIQUE OF IMPRESSION TAKING

The trays used were adapted by cutting and reshaping the smallest manufactured trays. All impressions were taken in compound and the bites in beeswax.

The infant is placed on his back with a small pillow under his shoulders, permitting an easier entrance for the tray. For maxillary impression the tray is inserted from the head end, while the assistant, standing at the foot end, holds the infant's mouth open. It is difficult to keep the mouth open and the head steady, particularly when the child is over one year of age. This can be accomplished by placing the thumbs on the menton and the index fingers on the external auditory meatus, with the rest of the hand supporting the back of the head. With constant but gentle force, the mouth is opened and held firmly.

For the mandibular impression the tray is inserted from the foot end while the assistant stands at the head end. This time the assistant places the index fingers on the menton, and grasps the head with the palms of the hands. With older children another assistant may be required to hold the hands and feet.

ANATOMY OF THE MAXILLARY AND MANDIBULAR GUM PADS

The gum pads are segmented and correspond in number to the underlying deciduous tooth sacs. An elevation of the first permanent molar may often be seen lying distally and lingually to the second deciduous molar allocation. It has been shown that early in uterine life the gums consist of two distinct parts: labiobuccal and lingual (shaded area, Fig. 1). The former comprises the major mass of the gum pad, which houses the deciduous teeth. The lingual portion, however, is a relatively small mass, and with eruption of the deciduous teeth it loses its identity by merging with the tissue on the lingual aspect.

The lip groove is on the external aspect of the arch and is not well defined. The dental groove (*a*) is the result of the invagination of the oral epithelium into the underlying connective tissue. This groove (*a*), as well as the gingival groove (*b*), is well defined, but with eruption of the deciduous teeth, the dental groove becomes obscure.

The gum pad segments are divided by sulci which designate the interdental septa of the underlying deciduous toothsacs. The only exception to this is the posterolateral sulcus which marks the dividing line between the labiobuccal and lingual portions of the gums. According to West[4] the maxillary and mandibular arches present a similar development.

MORPHOLOGIC CHANGES OF THE MAXILLARY AND MANDIBULAR ARCHES

Most of the anatomic sulci and grooves present in the gum pads at birth are obliterated with the eruption of the dentition (Fig. 2). During the processes of growth and development the internal alveolar margin is less affected in change of contour than the external margin. In the maxilla the posterolateral sulci become obliterated at the emergence of the first or second molar, but no definite

distinction can be observed in the mandible. The everted edge of the gum pads, which is less prominent in the maxilla, lies lingually to the anterior teeth, whereas in the mandible the teeth lie lingually to the more prominent everted edge. Prior to the eruption of the anterior teeth, especially in the maxilla, the tissue gives the appearance of anterior fullness. In advance of the eruption of the molars the tissue presents a spherical fullness (Fig. 10).

The anterior space of the gum pads, when present, changes with development. This is illustrated by these sets of models (Fig. 3); casts *A* have a symmetrical opening at 2 months; at 5 months 25 days the casts *B* show an asymmetrical opening, while at 1 year 1 month 8 days the casts *C* show that the incisors have erupted with the elimination of the anterior space. In all instances the first molar segments are elevated. This is associated with the position and size of the underlying toothsacs.

Fig. 1.

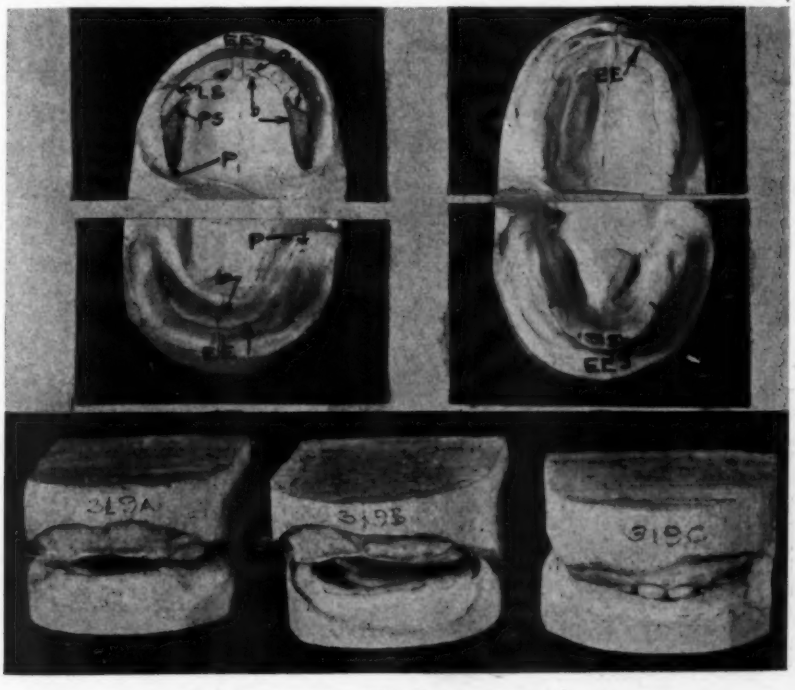

Fig. 2.

Fig. 3.

Fig. 1.—Anatomic landmarks of maxillary and mandibular gum pads. (Baby 23A at 10 days); (*a*) dental groove; (*b*) gingival groove; (*EE*) everted edge; (*LS*) lateral sulcus; (*PS*) posterolateral sulcus; (*P*) postgingivale.

Fig. 2.—Occlusal views of the maxillary and mandibular arches of Baby 23A at the age of 1 year 1 month 21 days.

Fig. 3.—Casts of Baby 319A illustrating: *A*, Symmetrical opening of anterior space at 2 months. *B*, Asymmetrical opening of anterior space at 5 months 25 days. *C*, Incisors erupted and anterior space eliminated at 1 year 1 month 8 days.

THE ERUPTION OF THE DECIDUOUS DENTITION

A tooth is considered erupted as soon as a cusp has pierced the oral mucosa. The erupted teeth of each series of casts were tabulated. In most instances the time is less, as some of these teeth had erupted before the impressions were taken. Adjusting our figures to conform with our observations, the eruption time is shown in Table I. My figures are slightly different from those of Kronfeld and Schour,[5] which may be due to different definitions of eruption.

TABLE I

ERUPTION OF THE DECIDUOUS TEETH

	MONTHS
1. Mandibular first incisors	6 to 8
2. Maxillary first incisors	7 to 9
3. Maxillary and mandibular second incisors	8 to 10
4. Maxillary and mandibular first molars	12 to 18
5. Maxillary and mandibular canines	16 to 20
6. Maxillary and mandibular second molars	20 to 30

DO THE GUM PADS MEET WHEN THE JAWS ARE AT REST?

The question as to whether or not the gum pads in the infant are in contact is still disputed, although the author's evidence shows that they do not meet. This is not purely an academic point, for if we make the gum pads meet, then we interfere with the true relationship of the jaws. To investigate this further, a random series of right and left lateral roentgenograms* on ten infants were taken with the mouth shut. In all instances the right and left lateral views showed the same degree of opening between the jaws. Fig. 4 *A* and *B* is an example of this opening between the gum pads, showing the narrowest and widest openings in this group. This evidence substantiates the author's earlier report.[1] Regardless of what viewpoint one may take, there is little doubt that in many instances a space[6, 7, 8, 9] does exist between the anterior segments.

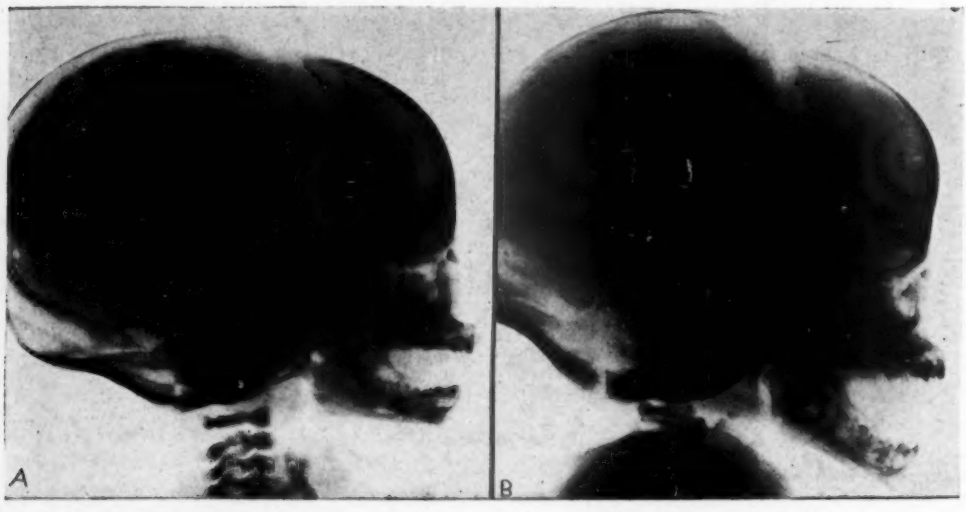

Fig. 4.—Roentgenograms of living 10-day-old infants. *A*, Narrowest opening between the gum pads. *B*, Widest opening between the gum pads.

DOES THE ANTERIOR SPACE BETWEEN THE GUM PADS HAVE ANY SIGNIFICANCE AS TO THE FUTURE OPEN-BITE?

The space between the anterior segments of the gum pads has been classified as follows (Fig. 5):

Class A—The maxillary and mandibular anterior segments lie in their respective planes.

*Courtesy of Dr. Louis J. Friedman, Director of the Department of Roentgenology, Bellevue Hospital.

Class B—In the maxillary, the incisor segments are higher than the canine segments, while in the mandibular, the anterior segments are in the same plane.

Class C—In the maxillary, the incisor segments are higher than the canine segments, while in the mandibular the canine segments are higher.

Class D—In the maxillary, the anterior segments are in the same plane, while in the mandibular, the canine segments are higher.

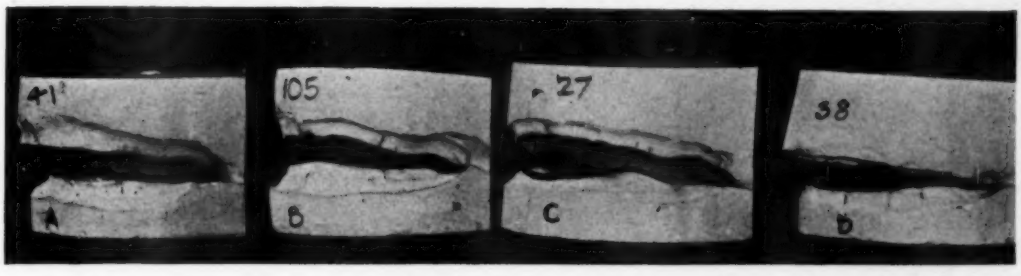

Fig. 5.—Casts illustrating the variations in form of the space between the anterior segments of the gum pads.

Some babies are not easy to classify but when their casts are orientated to a plane, which will be described presently, the matter is simplified. In Table II the twenty Class A cases have no space, whereas Classes B, C, and D together show fourteen babies who have a space; yet, regardless of classification there is no open-bite with the eruption of the teeth, except in one child (Baby 268), who at birth was in Class A. Therefore it is evident that the anterior space between the gum pads at birth bears no relationship to future open-bite.

TABLE II

CLASSIFICATION OF ANTERIOR SPACE BETWEEN THE GUM PADS

	TOTAL	CLASS A	CLASS B	CLASS C	CLASS D
Number	34	20	11	1	2
Percentage	100	58.8	32.4	2.9	5.9

HAS THE ANTERIOR SPACE ANYTHING TO DO WITH THE DEGREE OF OVERBITE?

The vertical dimension between the incisal edges is considered as the vertical overbite, and the horizontal dimension is considered as the horizontal overbite (Fig. 6). The dimensions were taken parallel or perpendicular to the plane of orientation, to be described. In order to eliminate as many variables as possible, only the children who had at least sixteen teeth were grouped.

Clinch[6] thinks that the children with an anterior space develop a normal bite whereas children with no anterior space develop a close-bite. She states, "From this it would appear that not only does the space allow for a normal overbite on the incisors, but its absence creates conditions that are unfavorable for forward growth of the mandible, and so prevents a posterior position of the mandible at birth from developing into a normal occlusion." Our findings do not support this view. Baby 4 (Fig. 7) and Baby 2106 (Fig. 8) illustrate two Class A relationships at birth, yet each developed into a good bite and good occlusion.

In our group of Class A infants the spread for the horizontal overbite is 2 to 6 mm., whereas for the combined Classes B, C, and D the spread is 1 to 6

mm., with a central tendency for both groups between 3 and 4 mm. (Table III). In Class A the vertical overbite varies from 1 to 4 mm., and from 2 to 4 mm. for Classes B, C, and D. The central tendency is between 2 and 4 mm. for both groups.*

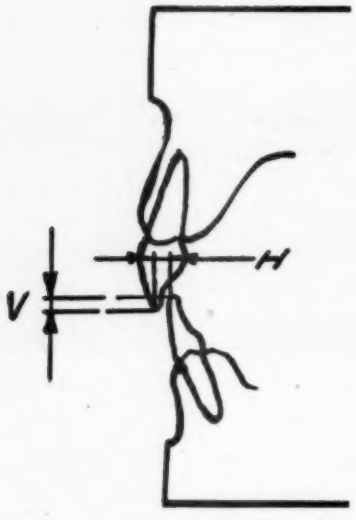

Fig. 6.—Illustrating horizontal and vertical overbite.

Figures do not always express the degree of overbite so we will consider the gross picture. When the mandibular incisors lie lingual to the gingiva of the maxillary incisors, this will be considered as a case of horizontal overbite. Then again, when the maxillary incisors overlap to the gingival tissue of the mandibular incisors, this will be classed as a case of vertical overbite. Under these terms, I find that of the twenty babies in Class A, only six would be classed as overbites (Table IV). Furthermore, of fourteen babies in Classes

TABLE III

RELATIONSHIP OF ANTERIOR SPACE BETWEEN THE GUM PADS AND THE OVERBITE OF THE INCISORS

	HORIZONTAL OVERBITE (MM.)						VERTICAL OVERBITE (MM.)					
	1	2	3	4	5	6	1	2	3	4	5	6
Class A, no anterior space		4	5	6	1	1	1	7	6	3		
Classes B, C, and D, anterior space	1	1	3	4		1			3	4	3	

TABLE IV

GROSS CLASSIFICATION OF OVERBITE

	GOOD BITE	OVERBITE		
		HORIZONTAL	VERTICAL	HORIZONTAL AND VERTICAL
Class A, no anterior space	14	4	1	1
Classes B, C, and D, anterior space	11	1	2	0

*All dimensions in this report are given in millimeters and are accurate to the nearest millimeter.

B, C, and D, three would be classed as overbites. The remaining fourteen babies of Class A and the eleven babies of Classes B, C, and D developed into good bites. These findings lead me to believe, therefore, that the anterior space of the gum pads in the newborn bears no relationship to the future overbite of the dentition.

Fig. 7. Fig. 8.

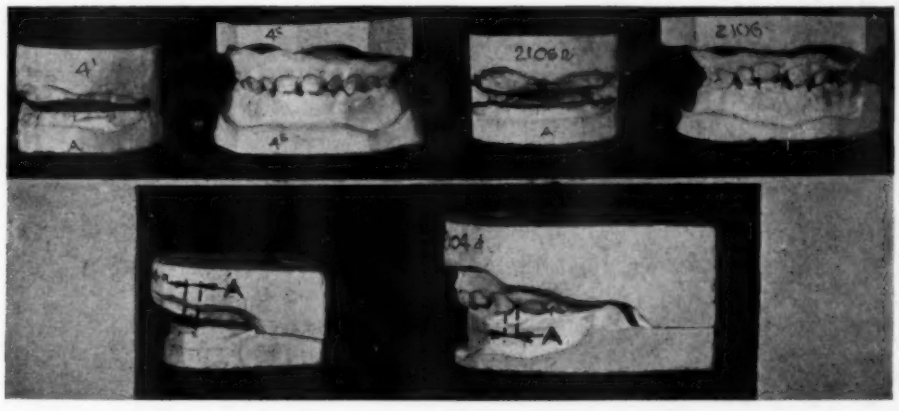

Fig. 9.

Fig. 7.—Casts of Baby 4. *A*, At 10 days, Class A, no anterior space. *B*, At 2 years 10 months, presenting normal horizontal and vertical overbite, good occlusion.

Fig. 8.—Casts of Baby 2106. *A*, At 3 days, Class A, no anterior space. There was a conical papilla, indicated by the circle *O*, at the mesial line of the maxilla. *B*, At 2 years 6 months, presenting normal horizontal and vertical overbite with good occlusion. The right maxillary incisors displaced due to a fall. There is quite a diastasis of the incisors due to cleft, which is traced throughout the series.

Fig. 9.—Casts of Baby 2104 illustrating Character A. *A*, At 7 days. *B*, At 2 years 4 months.

DOES THE ANTERIOR SPACE HAVE ANY BEARING ON THE OCCLUSION?

Occlusion is good when the triangular ridge of the mesiobuccal cusp of the maxillary first or second molar falls within the limits of the mesial or distal half of the cusps on each side of the buccal groove of the mandibular first or second molar. The maxillary molar should be in buccal occlusion. Sixteen babies with no anterior space and fifteen babies with an anterior space developed a good occlusion (Table V). However, under the divisions of malocclusion, despite the fact that there are four cases against none, we do not consider this in itself of any importance. On the other hand, if the number of babies with good occlusion was not practically equal to the group with an anterior space, then the values under the caption of Malocclusion might be very significant. In weighing this evidence and considering the types of malocclusion, it seems that no correlation exists between the anterior space and molar relationship.

TABLE V

ANTERIOR SPACE AND OCCLUSION

	GOOD OCCLUSION		MALOCCLUSION	
	NO.	PERCENTAGE	NO.	PERCENTAGE
Class A, no anterior space	16	45.8	4	11.4
Classes B, C, and D, anterior space	15	42.8	0	0

WHAT IS THE INTERRELATIONSHIP OF THE MAXILLARY AND MANDIBULAR ARCHES FROM BIRTH TO THREE YEARS?

In the newborn the establishment of the vertical dimension must depend on one's judgment. However, this is governed by observing the lower face height when the infant is at rest and also the fact that the gum pads do not meet. The anteroposterior relationship has been proved by the slight variations of repeated bites.[1] Prior to the eruption of the molars the anteroposterior and vertical relationships are difficult to establish. A bite obtained at this period represents, in most instances, a dynamic position of the relationship of the arches. Nevertheless, by means of this bite record, observations, and judgment, the rest position of the arches may be accurately related. When the molars are present the establishment of the relationship is simplified.

The interrelationship of the maxillary and mandibular arches during their growth and development is obtained by selecting pertinent landmarks. The lateral sulci points are chosen in the gum pads of the newborn infant. These points are the intersections of the lateral sulci and the crests of the gum pads. When the canines and first molars erupt, the corresponding points are at the crests of their interdental papillae. The measurements are taken parallel to the plane which passes through the lateral sulci points and the postgingivales or their equivalent. The reason for selecting this plane of orientation is the great variation of points anterior to the lateral sulci in the edentulous newborn. The evaluation of this mutual relationship is represented by *A* (Fig. 9).

To illustrate the varying interrelationships of the jaws with growth and development, Baby 1 was selected as an example because he has the largest series of casts (Table VI). Positive values of *A* indicate that the mandibular lateral sulcus is posterior, while negative values indicate that it is anterior. The first figure of the series shows that the mandibular arch is distal to the extent of 5 mm. The mandible "grows" forward at a greater rate than the maxilla so that at the fourth month the mandible is distal only to the extent of 3 mm. With the eruption of the mandibular incisors, there is further relative forward "growth" of the mandible so that now the lateral sulci are in the same plane. The value at 5 months 5 days is –2 mm. This figure does not give the value of the rest position of the jaws but does give an insight into the anteroposterior dynamics of the mandible. In other words, the mandible may assume a position of at least 2 mm. distal to 2 mm. mesial, or an anteroposterior movement of 4 mm. From 5 months 5 days to 1 year 7 months 21 days the infant does not seem to have a definite rest position of the mandible, as indicated by the variations of *A*. With eruption of the first molars and with function, an occlusal sense is developed. Further security is established when the second molars are added. This baby has a distal molar relationship on the left side, therefore the value for *A* is 0, whereas on the right side, which is normal, the value is –3.

In general the usual trend for all children is the same as described for Baby 1, with the exception that there are similar values for the right and left sides. Because of individual differences at birth there is a great variation of the relative forward "growth" of the mandible, ranging from 1 to 8 mm. Also there necessarily would be variations in time at which this "growth" occurs.

TABLE VI

CHARACTER A AT DIFFERENT AGES (BABY 1)

CHARACTER A (MM.)	AGE	
5	4 weeks 3 days	
2	11 weeks 4 days	
3	4 months	
–2	5 months 5 days	
0	6 months 6 days	Slight bulging of maxillary first incisors.
0	7 months 3 days	Increased bulging of maxillary first incisors, mandibular first incisors erupting.
0	8 months 14 days	
2	10 months 24 days	Maxillary central incisors erupting, mandibular first incisors erupted.
(a) –2	1 year 11 days	Maxillary second incisors erupting, slight bulging in maxillary molar region.
(b) –3		
–2	1 year 5 months 4 days	Marked bulging of all first molars.
L 2 R 0	1 year 7 months 21 days	First molars erupting.
0 –3	2 years 1 month 3 days	Sixteen teeth present.
0 –3	2 years 8 months 14 days	Twenty teeth present, distal occlusion on left side.

DOES THE INTERRELATIONSHIP AT BIRTH HAVE ANY BEARING ON THE FUTURE INTERRELATIONSHIP OF THE JAWS?

All of the babies had a distal relationship of the mandible at birth. From over 1,000 newborn infants, three were recorded where *A* was over 5 mm. at birth. The values for these children were 6, 7, and 11 mm., respectively. Unfortunately I have no follow-up on these three extreme cases.

Table VII shows that good occlusions are found for all values of *A* while malocclusions occurred when *A* was 2, 4, and 5 mm. This might indicate a correlation between the jaws at birth and the future interrelationship. However, the study of the individual series does not support this supposition.

TABLE VII

RELATIONSHIP OF GUM PADS AT BIRTH AND DENTITION

INTERRELATIONSHIP OF GUM PADS, CHARACTER A	OCCLUSION			
	GOOD OCCLUSION		MALOCCLUSION	
MM.	NO.	PERCENTAGE	NO.	PERCENTAGE
1	6	20	0	–
2	9	33.3	1	3.3
3	5	16.7	0	–
4	4	13.3	1	3.3
5	1	3.3	2	6.7

TABLE VIII

TYPE OF DELIVERY AND OCCLUSION

TYPE OF DELIVERY	OCCLUSION			
	GOOD OCCLUSION		MALOCCLUSION	
	NO.	PERCENTAGE	NO.	PERCENTAGE
Spontaneous	21	56.7	2	5.4
Nontraumatic				
Low Forceps	9	24.3	1	2.7
Mid B Forceps	3	8.1	–	–
Traumatic				
High Forceps	–	–	1	2.7

DOES THE TYPE OF DELIVERY HAVE ANY BEARING ON OCCLUSION?

A deformity may result mainly from two reasons: (1) physiologic and (2) mechanical. Moulding of the head is a general occurrence in a vertex presentation and clinically this produces a temporary deformity. Low forceps are usually prophylactic and reduce the labor period, which in turn may reduce the degree of moulding. No permanent injury should follow. On the other hand, mid-forceps A and B and high forceps may cause trauma to the cranium and upper part of the face.[10] All babies included in this report were vertex presentations and an injury occurred in only one case of a high forceps delivery where the upper part of the face was traumatized superficially. I have no serial records as yet of babies delivered by face presentation or cesarean section.

Spontaneous and low forceps deliveries usually are the nontraumatic types of delivery. When these are grouped, there are thirty babies with good occlusion and three babies with malocclusion (Table VIII). How can we account for these malocclusions? There must be other factors operating. Mid-forceps A and B and high forceps are the traumatic types of delivery and of these, three babies have good occlusion while only one baby has a malocclusion. This evidence does not suggest that the type of delivery is an etiologic factor in malocclusion. The individual serial studies further support this view.

DOES BREAST OR BOTTLE FEEDING HAVE ANY BEARING ON OCCLUSION?

Breast-fed is applied to those babies who were on the breast for three months or more. All except two of our babies were on the breast for a limited time. Bottle fed is applied to those infants who were fed artificially or who were on the breast for less than three months.

Prolonged bottle feeding is one of the factors to be considered in this study. Baby 283 was breast fed for three months and bottle fed thereafter. At 2 years 7 months he was still feeding from a bottle. Although he has irregularities of the maxillary incisors, there is no accentuation of this condition as recorded by the serial casts. Baby 238 was breast fed for four months and at 3 years 2 months he was still using a bottle. This child has a good alignment of his teeth and good occlusion throughout his series of casts.

The classification shows fifteen babies with good occlusion in the breast-fed group and seventeen babies with good occlusion who were bottle fed (Table IX). Of the malocclusions, there were two who were breast fed and two who were bottle fed. There seems to be no correlation between occlusion and the method of feeding.

TABLE IX

BREAST AND BOTTLE FEEDING AND OCCLUSION

	OCCLUSION			
	GOOD OCCLUSION		MALOCCLUSION	
	NO.	PERCENTAGE	NO.	PERCENTAGE
Breast	15	41.7	2	5.6
Bottle	17	47.2	2	5.6

IS THUMB- OR FINGER-SUCKING AN ETIOLOGIC FACTOR IN MALOCCLUSION?

A force of certain intensity and duration will change the position of the teeth and the surrounding structures. It makes no difference whether the

force is applied with an orthodontic appliance or a thumb, but we do have to be sure that such a force is operating.

The work of Haas[11] is most interesting. It is of paramount importance, however, to have casts before the onset of the sucking habit as well as during and after. Also, a study of children who are not suckers will reveal some amazing findings. Swinehart's[12] studies are of older children.

In my study, thirteen babies were thumb-suckers, of whom six started before 6 months of age; and eighteen were nonsuckers (Table Xa and Xb). The thumb was sucked with the palm upward, the arm sometimes resting against the chest, while at other times it was off the chest. Therefore, the support must have come from the jaws or from the shoulder muscles. One baby started to suck and bite his left thumb at about 8 months, so that an ulceration on the mid-dorsal portion of the second carpal bone resulted from the trauma. Others sucked the first and second fingers or the second and third fingers with the palm downward. Still another child sucked and bit his left index finger which he inserted at a slight angle with the palm turned parallel to the sagittal plane of the face. The tissue at the inner aspect of the union of the finger with the palm became ulcerated. The sucking started about the third month while the biting began about 2 months later. This child was bottle fed from birth and at 5 months he was given a solid diet to supplant cow's milk. Just how great a part the tongue and cheeks played in these habits could only be guessed. However, with some older suckers the repeated rhythmic concavity in the cheeks indicated that these organs were active.

From Table Xa it will be seen that under the caption of Suckers there are six babies with good incisal regularity against seven with irregularities, while under the group of Nonsuckers there are seven babies with good incisor alignment and eleven babies have irregularities.

In the group of Suckers there are eleven babies with good occlusion and two with malocclusion, while under the heading of Nonsuckers there are sixteen babies with good occlusion and two babies with malocclusion. This table indicates that sucking is not a cause of irregularity or malocclusion of the teeth within this age group. However, in order to give a closer approximation of the significance of these figures, each child must be studied individually and the findings evaluated accordingly.

For example, Baby 1 (Fig. 10) at 8 months sucked and bit his thumb, causing a callous formation. His tongue and cheeks played a part in his sucking, for when he removed his thumb from his mouth he emitted a sound which resembled a cork popping from a bottle. He had been breast fed for three weeks and bottle fed for thirteen months. At eight months 14 days the mandibular first incisors showed the early stages of eruption, and the maxillary first incisal segments bulged, as occurs prior to the eruption of teeth. At 10 months 24 days the maxillary incisors had erupted with a space between them. At 1 year 11 days the four maxillary incisors were present. The second incisors were rotated mesially while the first incisors were slightly protruding and appeared to be in a relatively similar position, only there was further eruption. The right mandibular first incisor was slightly lingual to its mate. The serial casts from 1 year 11 days to 2 years 8 months 14 days show

the positions of the teeth are relatively maintained. The only significant change is the closing of the space between the maxillary incisors. I have a series of fifteen sets of casts with twenty-five individual bite records of this child. If the thumb-sucking habit, which persisted for over two years, were an active force, should we not have found an increasing protrusion of the incisors? But such was not the case.

In order to get further insight into this question, let us turn our attention to three bottle-fed children of the same family. The youngest boy (Fig. 11)

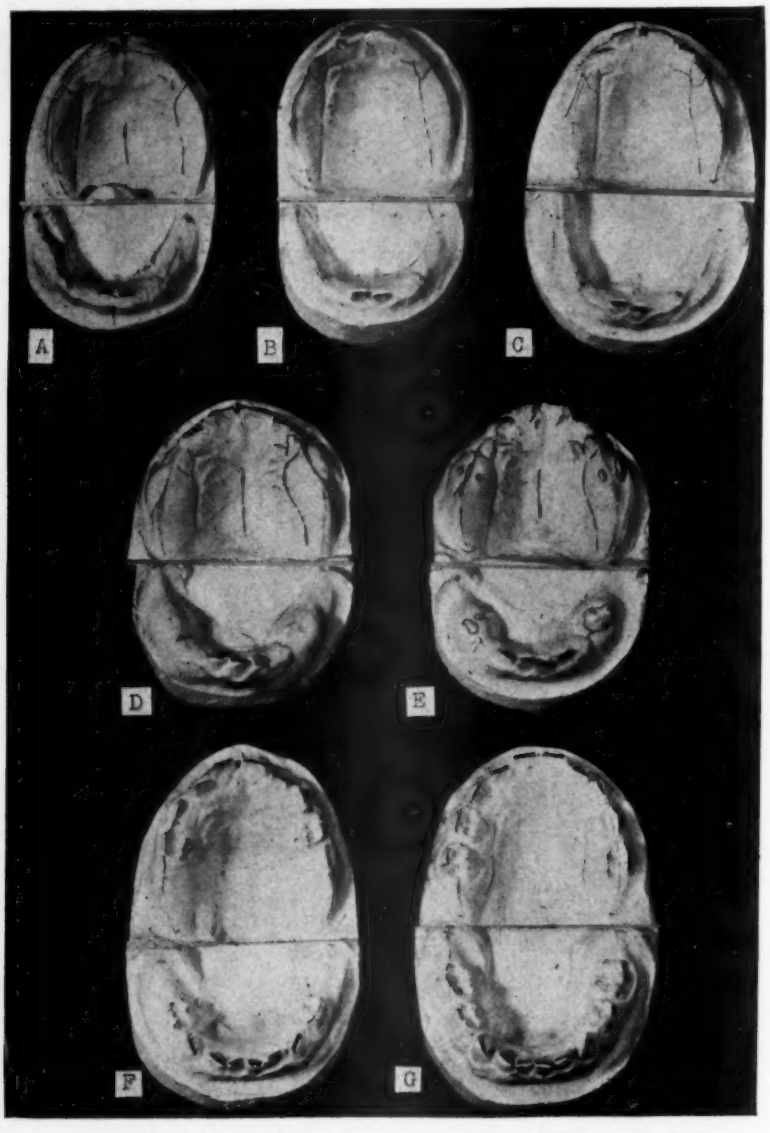

Fig. 10.—Occlusal views of maxillary and mandibular arches of Baby 1. *A*, At 8 months 14 days, bulging of maxillary first incisors and erupting mandibular first incisors. Note lingual position of same with respect to the everted edge. *B*, At 10 months 24 days, maxillary first incisors have erupted, mandibular first incisors have erupted further and have moved anteriorly. Note the posterolateral sulci. *C*, At 1 year 11 days, buccal fullness in maxillary first molar region. *D*, At 1 year 5 months 4 days, spherical fullness in region of all first molars. *E*, At 1 year 7 months 21 days, all first molars are erupting. *F*, At 2 years 1 month 3 days, note the posterolateral sulci. *G*, At 2 years 8 months 14 days, all deciduous teeth are present. The maxillary first incisor slope has not changed and all irregularities are maintained during development.

was a thumb-sucker from the age of 1 month. The first incisors were in good position while both second incisors were markedly rotated, as seen in the casts made when the child was only 1 year 1 month 8 days, and in the casts at 1 year 5 months there was no change in the position. The elder brother (Fig. 12) at the age of 1 year 2½ months showed markedly protruding first incisors and irregular second incisors. Similar protrusion was seen in the casts from 1 year 6 months 9 days to 2 years 6 months 9 days, yet this child never sucked his thumb. This demonstrates that logic and fact do not always dovetail. The sister of these two boys (Fig. 13), had similar rotations of the two maxillary incisors. She did not suck her thumb.

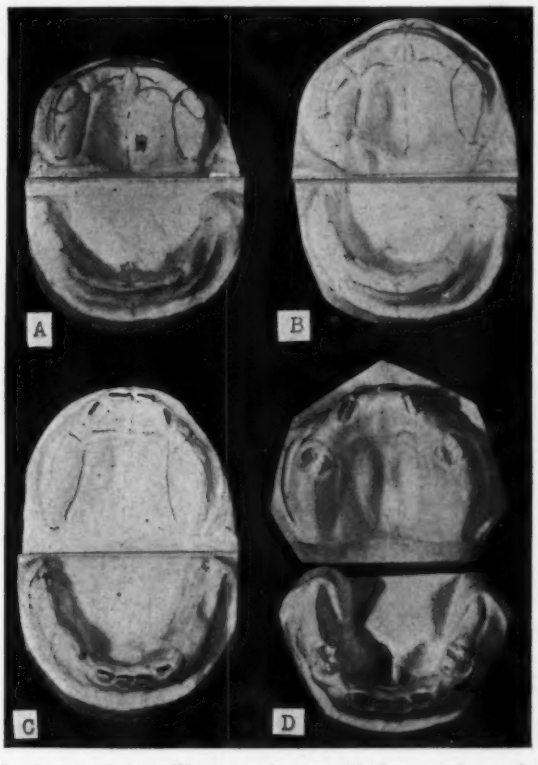

Fig. 11.—Occlusal views of maxillary and mandibular arches of Baby 319A. *A*, At 2 months, the flattened appearance of the maxillary first incisor region is a developmental process. *B*, At 5 months 25 days, this region has rounded out. *C*, At 1 year 1 month 8 days, marked rotation of maxillary second incisors and vertical position of maxillary first incisors; asymmetry in left side of the maxilla. *D*, At 1 year 5 months, position of teeth relatively maintained.

Baby 15 (Fig. 14) is a girl, breast-fed for three months, who started to suck her right thumb and at times the index finger, at the age of 1 year 6 months. At 2 years 6 months the mother, on her own initiative, placed splints on the child's elbows just before she was put to sleep and then removed them while the child was sleeping. To the mother's surprise the sucking was resumed during sleep. The casts at 11 months show that all the incisors were erupting in beautiful regularity. At 1 year 3 months the first molars were beginning to erupt. This was three months before the sucking habit started. At 2 years 6 days the child had sixteen teeth, regular and in good occlusion. At 2 years 7 months 26 days the child had a full complement of teeth in excellent alignment. Yet this girl had sucked her thumb or index finger for over a year.

Her younger brother (Fig. 15), who was bottle fed, started to suck his finger at 3 months of age and 2 months later biting was superimposed on the sucking habit. He put his left index finger into his mouth up to the palm and sucked and bit so lustily that the tissues were traumatized. When he was 9 months 11 days old the teeth in the mandible were slightly irregular, while in the maxilla, the second incisors were rotated and the left first and second incisors were displaced anteriorly with a space between the first incisors. At 1 year 1 month, as

Fig. 12.

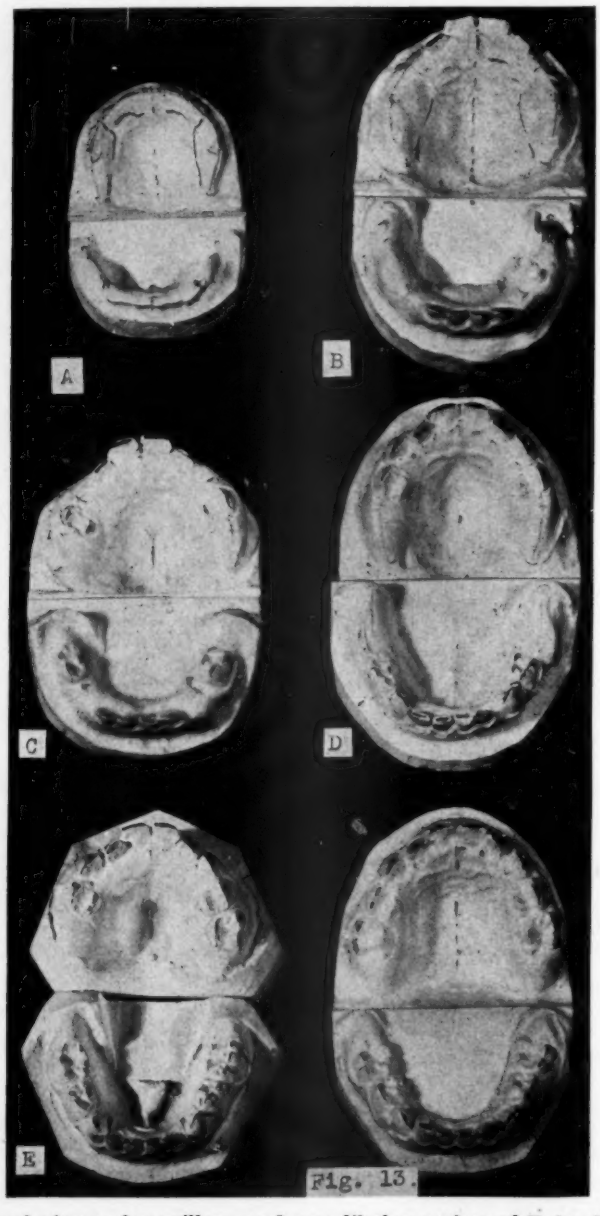

Fig. 12.—Occlusal views of maxillary and mandibular arches of Baby 319a. *A*, At 9 days. *B*, At 1 year 2½ months. *C*, At 1 year 6 months 9 days. *D*, At 2 years 1 month 22 days. *E*, At 2 years 6 months 9 days. Note rotation of maxillary second incisors and incisal slope of maxillary first incisors.

Fig. 13.—Occlusal views of maxillary and mandibular arches of Baby 319I. (Sister of babies 319A and 319a.) At 3 years 4 months 19 days, rotations of maxillary second incisors.

the sucking continued, the mother, again on her own initiative, applied aluminum mittens for 6 weeks, which arrested the habit. The last record at 1 year 5 months shows all sixteen teeth in place, with the left first and second incisors in somewhat better alignment and the space between the incisors closed. This case suggests that the active force may have been the cause of the displacement, which we believe was actuated by biting rather than by sucking.

Fig. 14.

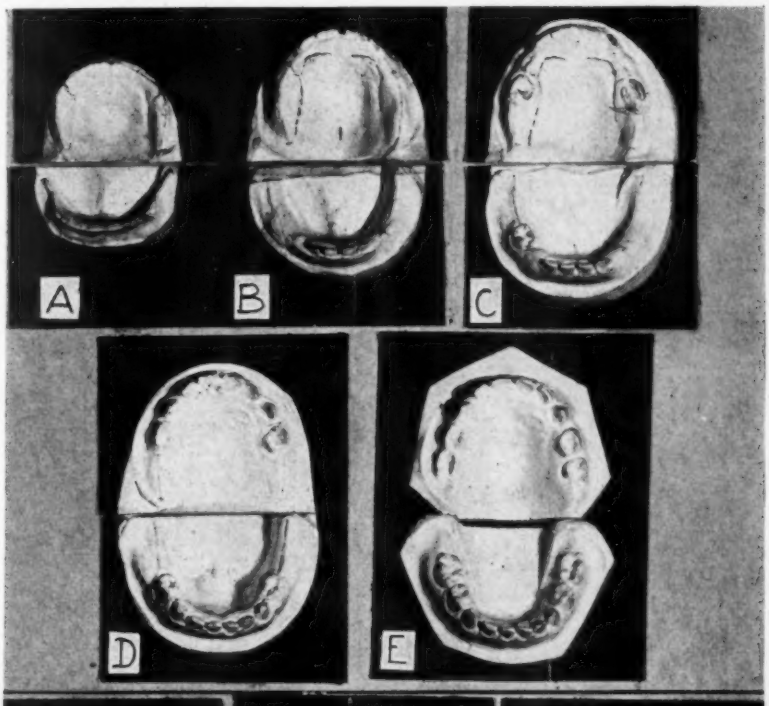

Fig. 15.

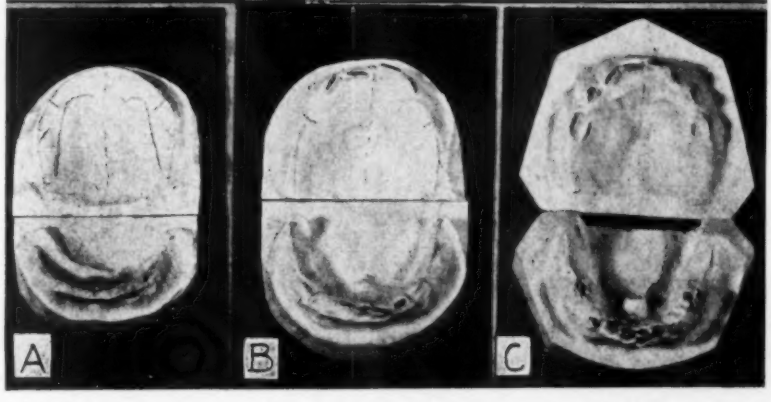

Fig. 14.—Occlusal views of maxillary and mandibular arches of Baby 15. *A*, At 6 days. *B*, At 11 months. *C*, At 1 year 2 months 27 days. *D*, At 2 years 6 days. *E*, At 2 years 7 months 26 days.

Fig. 15.—Occlusal views of maxillary and mandibular arches of Baby 15A. (Brother of Baby 15.) *A*, At 1 month 6 days. *B*, At 9 months 11 days, displacement of maxillary first and second left incisors and irregularity of mandibular incisors. *C*, At 1 year 5 months, displacement not so marked but same irregularity in mandible.

Baby 16 (Fig. 16) suggests the possibility that in some instances sucking may be a factor in producing a deformity. She started to suck her right thumb at 1½ years. The casts at 3 years 11 days suggest a dental deformity in the region where the thumb was placed. However, one cannot be certain that this

condition was caused by the sucking as I have no casts before the act was started, the previous record having been taken at 6 months.

Baby 268 (Fig. 21) was breast fed for 6 months. He possessed no habits such as sucking, biting the thumb, lips, or tongue, nevertheless an open-bite developed.

Furthermore, upon examination of the casts taken at various intervals, incisor irregularities are found to be characteristic to both thumb-suckers and nonsuckers; i.e., the first incisors have anterior incisal edge slope while the second incisors rotate mesially. Moreover, if thumb-sucking causes irregularities, how can we account for the six cases of good incisor relationship in the thumb-sucking group (Table Xa), or the eleven cases with irregularities in the nonsucking group? Therefore, it seems that this evidence points to factors other than these habits, with the possible exception of the two cases cited.

TABLE Xa

SUCKING HABIT AND IRREGULARITY OF THE TEETH AND MALOCCLUSION

			INCISOR RELATIONSHIP		OCCLUSION	
			GOOD	IRREGULAR	GOOD OCCLUSION	MALOCCLUSION
Suckers 13	Breast	4	3	1	3	1
	Bottle	9	3	6	8	1
Nonsuckers 18	Breast	10	2	8	9	1
	Bottle	8	5	3	7	1

TABLE Xb

SUCKING HABIT AND IRREGULARITY OF THE TEETH AND MALOCCLUSION (PERCENTAGE)

			INCISOR RELATIONSHIP		OCCLUSION	
			GOOD	IRREGULAR	GOOD OCCLUSION	MALOCCLUSION
Suckers 41.8	Breast	12.8	9.7	3.2	9.7	3.2
	Bottle	29.0	9.7	19.4	26.0	3.2
Nonsuckers 58.2	Breast	32.3	6.4	25.8	29.0	3.2
	Bottle	25.9	16.1	9.7	22.6	3.2

WHEN MAY THE SUCKING HABIT CAUSE A DENTAL DEFORMITY?

I have shown that the sucking habit of itself, in most cases, has not produced a dental deformity up to the age of 3 years. It is conceivable, however, that a passive sucking force may be turned into a active one. Anxious parents who constantly pull the child's thumb out of his mouth, accompanied with the customary "Don'ts" just make the child suck all the harder, and start up a chain of tensions more detrimental psychologically than the possible dental deformity. The chances are that the child would eliminate this habit with a minimal amount of dental and psychologic trauma if he were given appropriate care without adult annoyance and interference.[13]

In a recent study of a group of seventy suckers, Johnson[14] states that, "60 per cent had the habit broken by the end of the third year." These

figures show that the majority outgrow this habit, and it is quite possible that the percentage would be even greater if parents had a better understanding of the psychologic development of their children.

WHAT IS THE PHYSIOLOGIC BITING URGE?

The urge to bite is physiologic and may be manifested prior to and during the eruption of the deciduous teeth. However, it is most pronounced with the coming of the mandibular first incisors and first molars, occurring between 4 to 8 months and 10 to 18 months respectively. In general, these urges can be recognized by marked drooling, biting, and thrusting forward of the mandible. It has been observed in many instances that the infant, in his attempt to occlude the gum pads in the first molar region, moves the mandible forward so as to present a Class 3 relationship. In four babies I have recorded this relationship. With the eruption of the molars and the accompanying vertical growth of the alveolar bone, the mandible will settle into the most convenient position.

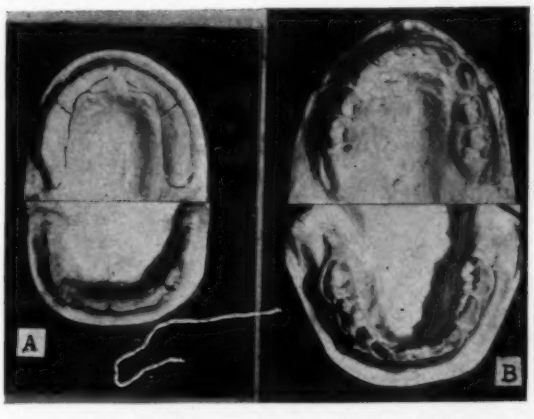

Fig. 16.—Occlusal views of maxillary and mandibular arches of Baby 16. *A*, At 6 months. *B*, At 3 years 11 days.

The child must give vent to this instinct. It should be just a question of which is the best method to satisfy this urge. If the chewing of food would satisfy this, it would be ideal, but this does not prove to be the case. The mother may give the child a simple rubber ring, if the child has not already inherited a family heirloom, such as an ornamental teething ring. Less fortunate babies are very happy to insert into their mouths whatever is most accessible, and may resort to their fingers or thumbs. Under such conditions, if the sucking habit is present, the biting urge also may become a habit. Biting is an active force and, if pyramided upon a finger- or thumb-sucking habit, may be a prelude to a dental deformity.

I made a stick of rubber, ⅛″ by ¼″ by 4″, of a certain consistency and found this to be a satisfactory means of helping the baby through this developmental stage, besides strengthening the muscles and aiding in developing the movements of the mandible. This procedure may solve some of the chewing problems which arise occasionally. The babies introduced to this stick in the proper manner and at the appropriate time, had a satisfactory and happy time biting it and did not resort to their thumb or fingers. When the urge terminated the child had no further use for it.

HOW EARLY MAY IRREGULARITY AND MALOCCLUSION BE RECOGNIZED?

Brash[2] asked this question and we will attempt to answer it. Irregularity of the teeth in the fetus has been found by West,[4] Schwarz[15] and the author.[1] However, one might ask, "How do you know that these irregularities are not just stages of development?"

We have shown asymmetric rotation of the incisors in the stillborn and the newborn,[1] which I believe to be irregularities, yet there is every right to question this as well. Logan[16] expresses the view that at 9 months the anterior teeth in the maxilla have enough space to allow them to stand in a perfect arch, yet Anderson[17] illustrated an instance where this did not occur. Sixty per cent of the babies had irregularities consisting of rotations and protrusions as soon as the teeth were erupted and they maintained the same degree of irregularity in all the series of models. It is doubtful that these are just developmental variations.

Fig. 17.

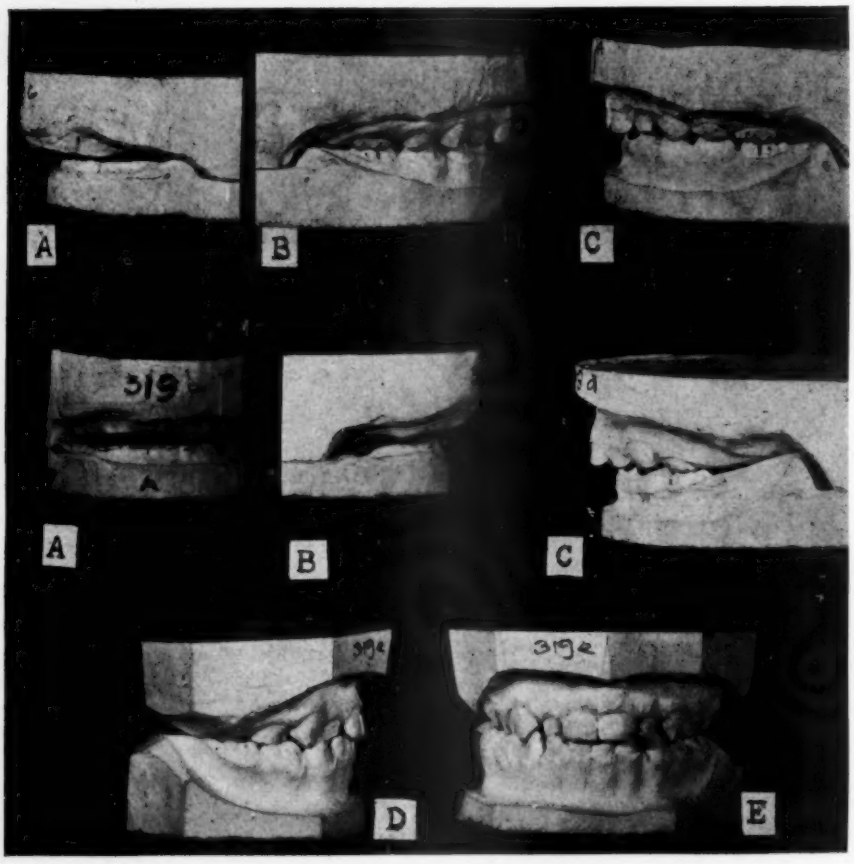

Fig. 18.

Fig. 17.—Casts of Baby 1. *A*, At 1 month, left lateral view (Class A). *B*, At 2 years 8 months, right lateral view, good molar relationship. *C*, At 2 years 8 months, left lateral view, distoclusion.

Fig. 18.—Casts of Baby 319a. *A*, At 9 days, anterior view (Class A). *B*, At 9 days, right lateral view. *C*, At 2 years 1 month 22 days, left lateral view, distoclusion. *D*, At 2 years 6 months 9 days, anterior view, maxillary right second incisor in linguoversion. *E*, At 2 years 6 months 9 days, right lateral view, mandibular first and second molars in buccoversion.

If the word malocclusion is used with reference to the relative molar relationship, it will be found that as soon as the first molars occluded Baby 1 (Fig. 17) had a distal molar relationship on the left side. This is recorded at 2 years

1 month 3 days and again at 2 years 8 months 4 days. The same condition holds true after 3 years of age. As a matter of fact, these measurements suggest a distal relationship even before the eruption of the first molars.

Baby 319a (Fig. 18) shows a bilateral distal occlusion at 1 year 6 months 9 days, which is still present at 2 years 1 month 2 days. At 2 years 6 months 9 days he had a full dentition with the exception of the maxillary right second molar. His jaws could be made to occlude distally but when he closed voluntarily his right maxillary second incisor and first molar occluded in the lingual version which rotated the mandible to the right of the sagittal plane. The marked protrusion of his maxillary first incisors and the rotation of the second incisors are retained throughout the series. It seems as if the malocclusion of this baby

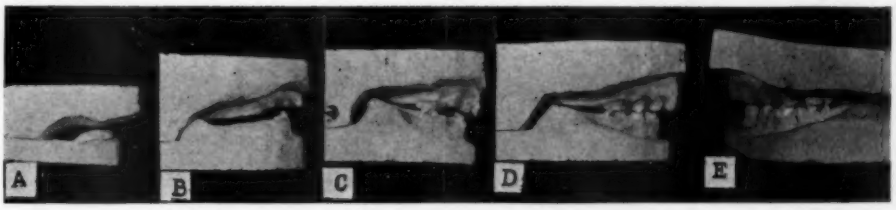

Fig. 19.—Casts of Baby 283. *A*, At 10 days, right lateral view. *B*, At 1 year 5 months 11 days, *C*, At 1 year 9 months 1 day, buccal occlusion of distobuccal cusp of mandibular first molars. *D*, At 2 years 4 months 20 days, right lateral view, *E*, At 2 years 7 months, left lateral view, distoclusion with distobuccal cusp of mandibular first molars locked out buccally.

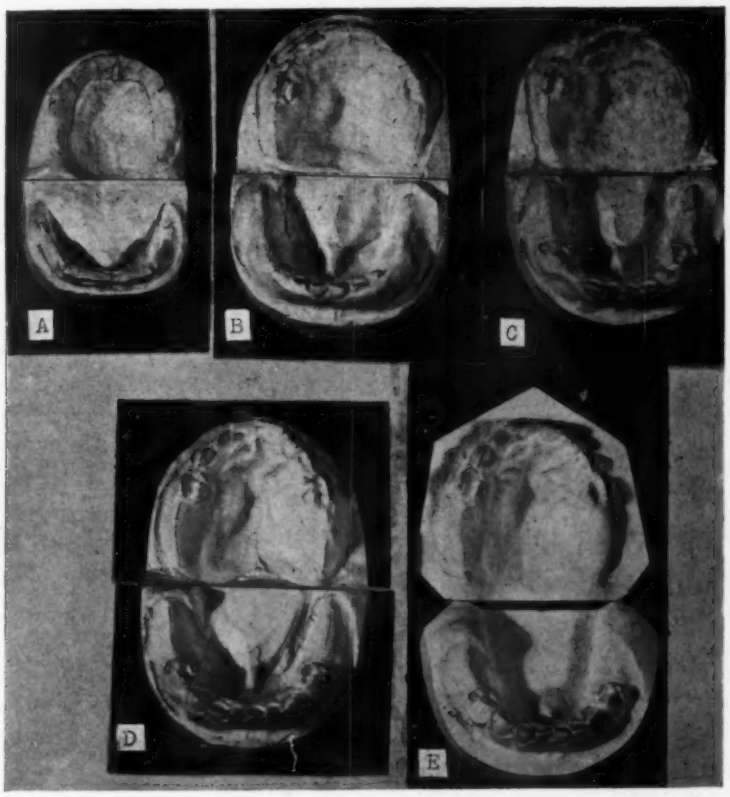

Fig. 20.—Occlusal views of maxillary and mandibular arches of Baby 283. *A*, At 10 days, *B*, At 1 year 5 months 11 days, *C*, At 1 year 9 months 1 day, *D*, At 2 years 4 months 20 days, *E*, At 2 years 7 months, same rotation of the mandibular first molars throughout series: also general irregularity of the other teeth maintained.

as well as of Baby 1 is due in part to the interference of the maxillary right second incisor.

Baby 283 (Fig. 19 and Fig. 20) at 1 year 9 months 1 day shows the mandibular molars rotated about 30° mesially. In addition, the distobuccal cusps are markedly prominent and this locks the occlusion. At 2 years 4 months 20 days these molars are just as rotated but the molar relationship now appears to have a distal tendency. The horizontal overbite was 4 mm. at 1 year 9 months 1 day, while it was 6 mm. at 2 years 4 months 20 days. At 2 years 8 months 9 days the overbite was 4 mm. with all the initial irregularities of the teeth still present. The variants of the overbite may be due to the lack of an occlusal sense, possibly because the second molars had not erupted.

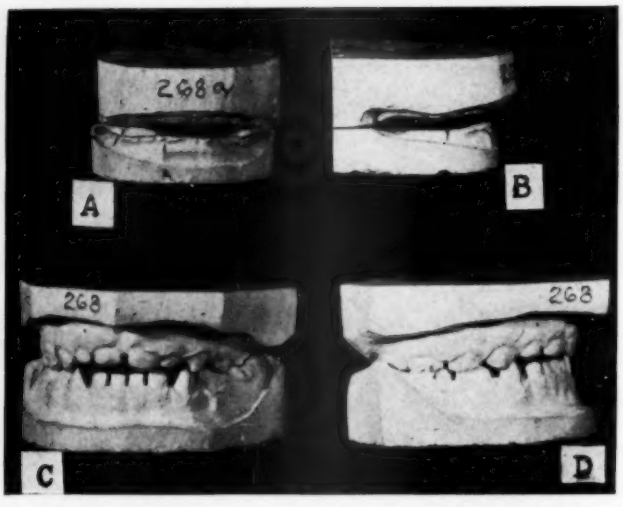

Fig. 21.—Casts of Baby 268. *A*, At 9 days, anterior view (Class A). *B*, At 9 days, lateral view. *C*, At 2 years 7 months 21 days, anterior view, note open-bite. *D*, At 2 years 7 months 21 days, lateral view.

Baby 268 (Fig. 21) developed an open-bite. The casts at birth are in Class A relationship. At 1 year 5 months 16 days there is no suggestion of an open-bite. The casts taken at 1 year 9 months 13 days show an open-bite, while at 2 years 7 months 24 days all the teeth have erupted and the open-bite has increased. There is a tendency towards a lingual version of the maxillary second molars. Even if these teeth were in better occlusion the open-bite would still be present. There was no habit to cause this deformity.

Will these irregularities and malocclusions be retained? Will some new aspects develop in the children with good alignment and occlusion? These questions will be answered by time.

SUMMARY

1. The gum pads at birth are not in contact when the jaws are at rest.

2. The mandibular gum pads at birth are distal to the maxillary gum pads.

3. The anterior space between the gum pads bears no relationship to the future open-bite; to the degree of overbite; to the occlusion of the molars.

4. The mandible "grows" forward at a greater rate than the maxilla, varying in magnitude and in time.

5. The interrelationship of the gum pads at birth has no bearing on the future interrelationship of the jaws.

6. The type of delivery is not an etiologic factor in malocclusion.

7. The occlusion is not influenced by the method of feeding.

8. Thumb-sucking or finger-sucking does not appear to be an etiologic factor in irregularity or malocclusion, except possibly in two cases.

9. Prominent physiologic biting urges occur between the ages of 4 to 8 months and 10 to 18 months.

10. In 60 per cent of the babies irregularities of the teeth are present from the time of eruption, and remain so throughout the first three years.

11. In 13 per cent of the babies malocclusions are present as soon as the teeth occlude.

12. We would be able to treat cases more intelligently and give a more accurate prognosis if we could observe them from birth.

13. Long-range serial studies will answer some of the important questions regarding the etiology of irregularities and malocclusions of the teeth.

I wish to thank Dr. Charles Hendee Smith, Dr. William E. Studdiford, and Dr. Leo Winter in whose departments at Bellevue Hospital part of this study was carried out; and Dr. Harry Bakwin who was always ready to help, and finally the parents and children who cooperated in this study.

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THE USE OF HYDRO-COLLOIDAL IMPRESSION MATERIAL IN ORTHODONTICS

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RECORDS

RECORD casts, of course, are an important step in any orthodontic treatment. They are a most important part of any system of diagnosis, and a diagnosis is no more accurate than the casts which form this part.[1, 2] Accuracy of dimension; accuracy of relationship of one tooth to its neighbors; accuracy of relationship of one arch to the other—possible only with accurate individual casts; and accuracy of detail of individual tooth anatomy without resort to sculpturing are obtained more definitely by the use of the hydro-colloidal material for the impression than in any other way.

To simplify the impression procedure for the patient and operator, a water-cooled tray is essential. The tray should be of minimum bulk and anatomically correct in its design. The tray should be so designed that it should never be necessary to add wax or compound to it, as unequal cooling results from this addition. Select the brand of material which seems to work best for you, study its working properties, and then stick to it. The use of the "mixing gun" will save time and material and having two "guns" available will be a further saving in time. The technique of taking the impression is by now an ordinary procedure, particularly with a water-cooled tray. It seems most efficacious to have the tray connected to the water supply at the chair with the water shut off. The material is heated in the gun in a boiler in the laboratory, cooled to a temperature just a little above the temperature at which it is to be introduced into the mouth, and the gun carried to the chair where the material is ejected into the tray. Each operator can work out his most efficient technique. Depending on the temperature of the water supply, from one to three minutes' water flow will cool the impression, if the most efficient tray is used. The removal from the mouth should be done carefully in spite of the elasticity of the material.

If the impression is not to be poured immediately, place it in a jar that can be sealed. A one-pound ointment jar with a screw cover is ideal. Never completely immerse the impression in water for more than a few minutes, but put a little water in the jar with the impression and seal. The pouring may then be delayed until the next day. Casts made from colloid impressions give distinct detail and without distortion, and gnathostatic casts may be made with but little change in the usual procedure of making gnathostatic registrations. The facility with which colloid impressions are taken with children should be reason enough for its use in obtaining accurate casts.

APPLIANCES

If appliances are to be made indirectly, the record casts may be duplicated by use of hydro-colloid, or a second set of impressions taken of the patient. The

preferred and most accurate procedure, of course, is the forming and fitting of bands directly on the teeth. The labial arch will be considered first. The molar anchor bands and bands for other teeth are formed and fitted, but no attachments added. Now, with all bands in place, an impression with hydro-colloid is taken, and the bands carefully removed from the teeth. The impression will show well defined imprints of the bands. If the impression is to be processed later, it is placed in a jar as explained before. Drop the bands in with the impression for safe keeping.

Figs. 1 to 3.—Types of cases in which it is difficult to obtain a good impression with any other material. The colloids are ideal.

When ready to process, remove any excess moisture from the impression, particularly from the imprints of the bands. Flow a *thin* lining of wax on the inside of the bands and drop them into their respective and proper positions in the impression. Tease them gently into place. Small lugs, which may be clippings from thin (0.003″) material, 0.125″ or 0.150″ wide, are formed into angles as shown in Fig. 4. These are pushed into the impression material, long end first, close to the exposed edge of the band, but not touching it. Two lugs are placed buccally, and two lingually at the "angles" of the molar bands, but

only one labially and one lingually need be used on anterior bands. With a small instrument, each band is held accurately in its imprint, but not pressed, and a drop of wax is placed at each lug, connecting it and the band with wax. Wax is then flowed around the exposed portions of the molar bands, and built up to the gingival edge, making a collar all around the band exactly flush with the edge. When the cast is made, this will form an exact shoulder, which will be an aid in observing the proper set of the band when later handled. The impression now may be mildly vibrated during the pouring of the plaster, without danger of the bands leaving their proper positions. A quick-setting refractory plaster material may be used, but the addition of about one part of a refractory material to four parts of cast plaster gives a satisfactory, durable model. When the cast has been poured, separated, and dried, the wax around the molar bands is removed, the bands warmed, and gently freed from their plaster teeth. Precious metal bands need not be removed from their plaster teeth, as all the soldering can be done directly while on the model. Attachments to the bands and arch wires may now be made on this model with the assurance that, when transferred to the patient, they will fit exactly as made on this accurate representation of the jaw.

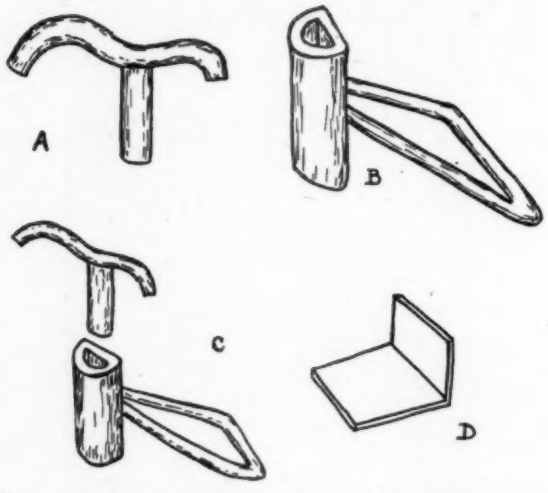

Fig. 4.—*A*, Male jig which fits into half-round tube on band in the mouth. Half-round shaft, 14 gauge, 1/8″ or 5/32″ long.
B, Female portion of jig assembly which eventually becomes a part of the plaster work-cast. Half-round tube for 14 gauge shaft.
C, Jig assembly, which when put together is waxed into place in the impression.
D, Lug used for waxing bands in position. Clippings of 0.003″ by 0.125″ band material. (All parts greatly enlarged.)

THE LINGUAL ARCH

In constructing a lingual arch, upper or lower, an essential requirement is that it be absolutely passive on its first insertion, giving a proper starting point or "line of departure." Molar anchor bands are formed and fitted, and half-round tubes soldered into proper position on their lingual surfaces. Round buccal tubes or hooks for intermaxillary elastics, if used, are now added also, and the bands cemented on the teeth. The technique following is an adaptation of a technique suggested by Dr. Ralph Waldron, who used ordinary compound for the impression. This adaptation avoids the possible distortions accompanying the use of compound. Jigs such as shown in Fig. 4 are formed of a half-round

shaft of the same length as the tubes used, soldered to a piece of 0.040″ wire bent in a wavy pattern. The length of the wavy wire is parallel to the flat side of the half-round. The design of wave shown gives support in three dimensions and will tear a smooth path, which will be explained. These jigs are made left and right and are always kept on hand. The placing of these jigs into the half-rounds on the cemented bands is standardized, the longer end of the jig always facing backward. A colloid impression is now taken with jigs in place and chilled thoroughly. In removal of the impression the jigs should remain on the teeth and tear a path through the colloid, which will be explained later. Again the impression may be stored in a jar, and the jigs used in that impression are removed from the teeth and dropped into the jar also.

Fig. 5.

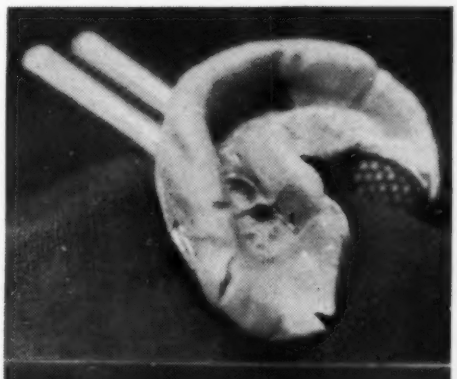

Fig. 6.

Fig. 5.—Impression of mandible showing male jig fitted down into its imprint and the loose material cleared from the path torn.

Fig. 6.—Showing the jig assembly and wire waxed, and the wax filling in the path torn in the colloid.

When ready to process, the excess moisture is removed from the impression, particularly from the path which was torn through the colloid material. The loose and overhanging material is carefully cleared from this path, being carved away until the imprint of the wavy part of the jig can be seen *clearly* from end to end. This imprint must be entirely clear of fragments and excess moisture, for the jigs are now carefully placed into the imprint in their respective places. By always having the longer end of the wavy wire placed posteriorly, it is readily determined where each jig is to fit. Now a female jig, made of a half-round tube to which a triangular shaped lug has been soldered at about a 45° angle as shown in Fig. 4, is carefully fitted onto the half-round shaft of the first jig. This half-round tube will represent the half-round tube in the mouth, so must be accurately fitted down to the wavy part of the first jig. This assembly will fit nicely into its proper place in the impression if the preceding steps have been

properly carried out. A piece of 0.010″ or 0.012″ hard wire is now introduced through the buccal part of the impression material in such a way that it will come close to, but not touch, the lug which protrudes into the cavity of the impression. Making sure that the jig assembly is properly in its place, connect the end of the small wire to the frame of the jig with wax. Place a drop of wax on the outer side of the impression where the wire protrudes, and also on the inner side. These three drops of wax will immobilize the jig assembly. Now fill with wax the path which had been torn and subsequently cleared, until the wax exactly replaces the colloid material carved away. The impression may now be poured with mild vibration without danger of dislodging the jigs. When separated, an accurate model of the teeth with a half-round tube in exact replica of its site in the mouth, has been obtained, and any appliance made thereon will fit exactly and in complete passivity, when transferred to the mouth.

RECLAIMING

While cost should never deter us from making use of newer and better methods for dental procedures, it is a factor, and it seems that a more widespread use of the colloids has heretofore been retarded by their seeming cost. I can see no practical reason why this material cannot be reused, *provided* it is properly handled and *positively sterilized.* Unlike other impression materials, it can be boiled, and prolonged boiling even for hours under proper conditions does not seem to affect its practical use. As mentioned before, colloid materials should never be kept immersed in water for more than a few minutes since absorption of water will swell the material and distort an impression.[3] Neither should an impression be allowed to remain open to the air for more than a few minutes because the drying out of the normal water content will of course shrink and distort the material. The placing of the impression in a sealed jar with a little water has proved practical and impressions have been so kept for as long as a week with no apparent damage. A simple test can be made by suspending a portion of a stick of colloid in a jar so that it does not touch the water in the bottom of the jar. Measurements at the beginning of our test and again at the end of two months bore out the above contention. While it is true that according to Kern's tests there is a shrinkage of specimens in 100 per cent humidity, the amount of shrinkage is more of theoretical than of practical importance, if kept in 100 per cent humidity.

As to the sterility of the reboiled material, a simple test seemed to prove the practicability of this procedure. A stick of each of four popular commercial hydro-colloids, and a stick of our reclaimed material, were put into separate test tubes under sterile conditions. The commercial sticks were expressed directly from their package tubes without being touched by the hands. Our reboiled stick was pushed directly from the sterilizer-stick-former into its tube. A little sterile water was added to each to provide excess moisture, and the test tubes were then plugged with sterile stoppers through which there was a small opening to the outer air. All, including our reclaimed stick, remained free from growths, while a control tube of contaminated material showed growths within a few days. Used scrap is freed of all foreign material, thoroughly washed, and stored either in a sealed jar *without* water, or in the inner cannister of the sterilizer. When

sufficient scrap has accumulated, the excess moisture is removed by spreading on a towel, after which it is placed in the sterilizer and boiled for forty-five minutes. During this time its temperature, of course, reaches 212° F. which is sufficient for practical sterilization. In the process, also, it melts down into the "stick-former" portion of the sterilizer, and when cooled, seven sticks of material of the proper size for the mixing gun are removed and sealed in a sterile jar (without water) until used. The principal physical requirement aside from removal of foreign material, is the proper water content. By learning the characteristics of one material, a little experience and study will acquaint one with the proper handling of the scrap. Generally, if the sterilized material is too thin in use, it means that it has not been "dried out" enough.

CONCLUSION

The hydro-colloids have taken an important place in dentistry and their continued use and study will, I believe, reveal applications, particularly in the field of orthodontics, that we do not yet appreciate. The seemingly easy use of this material should not cause us to feel that we can slight its procedures, but rather should we appreciate its characteristics and employ it as an improved tool.

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25 E. WASHINGTON STREET

DEVELOPMENTAL GROWTH OF THE FACE IN RELATION TO THE DENTURE

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RESPONSIBILITY in the preventive and corrective care of malocclusion, its relation to the physical, esthetic, and psychic welfare of our clientele, bespeaks a utilitarian conception of some of the knowledge gleaned from research and investigations on the interrelation of growth and development of the face and denture. The word *some* is used advisedly, for it is not within the scope of this paper to do more than embrace this subject in a fragmentary manner, hoping at least to promote the collateral study and constant clinical observation so necessary if we are to attain an appreciative amount of success.

An acquaintanceship with the normal growth patterns of the face and denture at different stages is obviously necessary if we are to recognize deviations from the normal when they appear. Realizing that the face and teeth must be looked at as a living functional ensemble, our present concept of the normal must be stimulated by the basic theories which hark back to John Hunter (1728-1793), who was the first to describe normal occlusion. It was in the latter part of the nineteenth century that Angle made a study of the significance of the normal, and his explanations were based on principles gathered over a wide field.[1] In Angle's seventh edition of *Malocclusion of the Teeth,* normal occlusion is defined as the "normal relations of the occlusal inclined planes of the teeth when the jaws are closed." As time passed, this conception broadened tremendously, and to the above may now be added "correct proximal contacts and axial positioning of the teeth, with normal growth, development, location, and correlation of the various associated tissues and parts." One need not wonder why Dr. Angle's understanding of the majesty and dignity of the human denture imbued him with the desire to visualize and interpret to his students the qualities of balance and harmony so prevalent in a face associated with and resultant of *normal occlusion.* He realized that the study of orthodontics is indissolubly connected with art as related to the human face, and that facial variations make standardization impossible. In these deductions he was tempered and influenced by his close associate and personal friend, Prof. Edmund H. Wuerpel, then director of the School of Fine Arts of Washington University in St. Louis and later a teacher in the Angle School of Orthodontia.

As to the difficulty of a standardized appraisal of the face and denture, one need but review the evidence set forth by Milo Hellman in 1921, and later in 1937, on the variation to be accounted for even when the teeth are in normal occlusion, that faces also vary regardless of the occlusion of their teeth and types, and are as variable as the personalities of the individuals

who are wearing them.[2, 3] Realizing this variation, Angle aptly held that "we should be able to detect not whether the lines of the face conform to some certain standard, but whether the features of each individual—that is, the forehead, the nose, the chin, the lips, etc.—balance, harmonize, or whether they are out of balance, out of harmony, and what concerns us most . . . is whether the mouth is in harmonious relations with the other features, and if not, what is necessary to establish its proper balance."

Our need therefore for a well-developed artistic sense is obvious. It is not enough that we appraise the physical appearance, as does the layman, by linear means alone; we must realize the face is but a veneer for the fundamentals of anatomy, developmental growth, and function. As stated by B. Holly Broadbent, "The face in its internal form and structure contains in a chronological sequence a detailed record of the individual's progress from birth to maturity."[4]

Though the teeth may well be looked upon as the main reason for the existence of the face, they are incapable of modification once they are formed and therefore void of adjustment possibilities.[5] This exigency is taken care of by the adjacent or juxtaposed tissues being of such nature as to meet this factor. The quality of mutability in bone makes it a favorable adjuster in its mission of affording attachment and an operating base. Primarily we are dealing with alveolar process, a most sensitive tissue remaining as a fixed base only so long as all the forces acting upon it through the teeth and associated musculature are in a state of static equilibrium, and this commensurate to dynamic balance. Physiologically it is considered a separate entity but histologically simulating the basal bones, developing around the teeth regardless of their positions and disseminating when they are lost. That the teeth and alveolar process eventually contribute to the design of the face and the relative developmental growth of all parts of the head is not surprising.

In comparing the bone surfaces of the skull at birth to the adult skull we find that the greatest growth of the skull lies below the supraorbital ridges with the greatest change taking place in the region of the mouth, being closely associated with the developmental growth and placing of the units indigenous to the organ of mastication. This appraisal should justly prompt us to realize that of all structures related to the teeth and face, there is none with which we should be more cognizant than bone.

Our problem being one of bone, before proceeding further let us review certain general considerations pertaining thereto. We know that each bone has attained a certain shape or typical form over centuries. During fetal life, at least, the development of bone into certain definite forms takes place independent of function or trophic functional stimuli. This independent bone formation is an hereditary power.[6] Further study of embryology and biology teaches that there is a definite plan of structure unfolding from a single fertilized cell to the completed individual, a predetermined highway, so to speak.[7] The maxilla and mandible will take on a size and shape that simulate a natural form even when edentulous. However, we must realize that no structural unit in the body can be molded to its complete and ideal form un-

less it feels the stimulating influences of the forces associated with its use. With bone this is particularly true.[8] Thus we are not presumptuous in assuming the two salient forces in the life of any bone are heredity and function. True to life the gradiency of each is variable, for the influence of function on real young bone, as stated above, is doubtful and reflection on the early life history of all animals bespeaks a dependency on factors over which they have no control up to a point in their development where they must shift for themselves. It is then that the inherited growth force becomes less influential and function, the activator of the associated forces, incremental in significance.

Suffice it to say, heredity, which we cannot control, may be said to lay down the architectural plan of bone and is indigenous to the true definition of growth, namely an increase of dimension or size through multiplication of cells, while function, which we can materially improve or assist, determines form and degree of development. This in turn has an influence on the definition of this process, namely, specialization to particular adaptation or change in proportion and adjustment of parts.[9, 10]

History informs us there was very little known about bone growth until the early part of the eighteenth century.[11] Belchier in 1736 and Duhamel in 1739-41-42-43 published papers on their experiences by madder feeding of animals. They may justly be given credit as pioneers in this method of bone study, which consists of feeding bran soaked in madder to experimental animals. Analysis shows this madder to contain two organic dyes, alizarin and purpurin, to which the calcium phosphate of the bone is supposed to act as a mordant. The forming bone therefore takes on a red stain. However, bone activity which is associated with deposition, namely absorption, required an indirect method. First the animal was fed madder for a period and then was given a madder free diet; thus the absorbing or quiescent areas showed red, and the new bone showed white.

Though little seems to have been gained besides the staining factor of bones by Belchier, Duhamel did set forth a theory of interstitial expansion, which proved to be a controversial deduction. It was the eminent English anatomist, John Hunter, who first concentrated his investigations on the head and face. He was the first to describe the growth of the jaws, and in turn normal occlusion. Most of the principles of orthopedic significance set forth in his *Natural History of the Human Teeth*, published in 1771 at the age of 43, are recognized today because of their scientific soundness.

To John Hunter must be given recognition for two basic concepts of bone: first, that growth was not equal in all parts of bone, and second, that bone grew by deposition on its free surfaces and was kept in a state of functional balance by compensatory resorption on other surfaces. This realization of the constant activity and plasticity of bone bespoke what was to become in 1870 the roots of the law of transformation of bone by Julius Wolff. This law, based on the findings of Wolff and his contemporaries, Culman and Von Meyer, reads as follows: "Every change in the form and function of a bone or of its function alone is followed by certain definite changes in its internal architecture, and equally definite secondary alterations in its external conformation in accordance with mathematical laws."

By comparative study of jaws, Hunter describes his findings by stating, "The jaw still increases in all points till twelve months after birth when the bodies of all the six teeth are pretty well formed, but it never after increases in length between the symphysis and the sixth tooth, and from this time, too, the alveolar process, which makes the anterior part of the arches of both jaws, never becomes a section of a larger circle, whence the lower part of a child's face is flatter, or not so projecting forward as in the adult." He also made the deduction by madder feeding to experimental animals that after the sixth year the main sights of growth in the maxilla and mandible were posteriorly, by the accretion of bone to the posterior border, while the ramus including the processes is at the same time remodeling by resorption of the anterior aspect of the coronoid and to a lesser extent of the condyle. With this deduction he disproved the theory of interstitial expansion by Duhamel and set up in its place the theory of internal absorption and external addition. In 1864 George Humphry verified Hunter's deduction of jaw growth by the simple but ingenious method of inserting wires through the lateral aspect of the ramus and around its borders, examining at subsequent periods their comparative positions.[12]

One must marvel at the contributions by Hunter to our present-day knowledge when we recognize that the microscope, invented about 1600, was not improved and used with achromatic lens until 1839, after which such men as Schleiden, Schwann, Goodsir, Gegenbauer, Kölliker, and others in the field of general science established the cell theory and determined histologically the manner in which bone changes occurred.

Among our more recent investigators in the field of growth who have used various methods of approach we must recognize Brash, Campion, and Kieth from abroad, and Hellman, Krogman, the late Todd, Broadbent, Margolis, and others in this country in their search for new facts and materials, with recognition that many of the scientific merits of Hunter's findings still stand the test of time.

Let us now relate some of the findings common to most of the methods which should enable us to realize the changes that accompany the growth of the face.

One outstanding deduction is, that adult bone, or aggregate of bones, differs in proportions from those of the infant. It is an uneven process. At birth the face is said to be one-eighth the bulk of the whole head, while in the adult it constitutes about one-half; however, the face increases about twelve times its size during the same period, while the brain case or cranium increases but four times.[13] This would indicate that the face is growing at a greater rate than is the cranium, which is not surprising when we realize that the brain is nearly complete in growth by fourteen years of age, while the face must follow through with its denture to a maturity at about twenty years. We are further informed that vast changes take place in certain areas in short periods of time with apparent rest in others followed by subsequent spurts of these backward sites. At times there presents a picture of apparent deformity which later presents a correction. It is this complicated

adjustment in direction and degree in growth that renders analysis of tooth positions in relationship to skull anatomy by anatomic surface points so uncertain. To determine the border line between the normal and the deformed presents a challenge to the anthropometric and cephalometric methods of approach. The latter, however, with the aid of roentgenograms, is proving an excellent check on the deductions of the anthropologic attacks by making it possible to study the same living individual throughout the entire growth period.

The cycle of developmental growth of the denture and face covers the period from the beginning of fetal life through childhood, adult life, and the decline which comes with senility, and all this as influenced by its phylogenic past. This paper will be limited in its concern to that period from birth to adulthood.

We shall endeavor to visualize the face in relation to the denture and in turn to keep in mind, first, the maxilla as entering into a complex structure of many bones, and having but three strong connections with the skull, viz., its own frontal process, the pterygoid process of the sphenoid bone, the zygoma. Second, that the mandible, though its companion in function, is disassociated except for articulation through the teeth and the condyles.

We may describe the change of relationship and adjustment of parts of these bones, for accommodation purposes, as a swinging forward, downward, and lateralward in three planes of space, but at different speeds and though suspended by articulations just set forth, as a unit pivoting about a point in the sphenoidal area. We find the bone structure of the face at birth to be at a low status of growth and development in comparison to the brain case, and set under and back thereto. This should not be surprising, for although the jaws are well packed with twenty-four tooth follicles, twenty deciduous and four first permanent molars, it may be said that up to this point function, which will now enter in the form of sucking and deglutition, has been practically absent. The respiratory area is immature, the maxillary sinuses being mere slits or foldings of the nasal mucous membrane. The orbit, which attains its approximate size stability at about 4 years of age, is serving as the base of the alveolar process and is at a slightly higher level than the floor of the nose or hard palate. The mandible shows even less vertical and horizontal growth. The angles are obtuse, the rami short, and the condyles poorly developed. At about 6½ years of age the jaws present more teeth and follicles than at any time in life. The deciduous units have been in function through actual occlusion for several years. In addition there are the active growing follicles of twenty-four permanent teeth, twenty crypts of which are lingually placed to the roots of the deciduous teeth with the purpose of inducing the mechanics of the wedge. The first permanent molars are in position, but are end-to-end in contact, having been guided into such placement by the vertical planes of the bases of the deciduous dental arch units, and later as their roots are more fully formed to withstand torsional stress and as the mandibular deciduous molars are lost, leaving more room than is necessary for the premolars, they will move forward to establish normal interdigitation.

It is interesting to see how the basic concepts of bone credited to John Hunter and previously referred to apply to the findings of the facial bone adjustment to accommodate the denture up to this point and in anticipation of the dental mechanism as it continues on to maturation.

Varying from the condition at birth, vertical growth has taken place resultant of the deciduous dentition erupting into occlusion and maintaining a relationship with the alveolar crest. The first permanent molars, which at birth were under the anterior aspect of the ramus or coronoid process, have been accommodated in the maxilla by additions to the tuberosity and in the mandible by the accretion of bone on the back of the ramus with a modeling absorption on its anterior surface. The angle between the ramus and body of the mandible is becoming more acute with the former lengthening.

As the succedaneous units erupt into occlusion we have an additional vertical growth, not only due to the greater length of the tooth crowns and the coincidental lengthening of the roots growing in an occlusalward direction, but due to the extensive alveolar growth associated with this change. Brash deduces that from 70 to 100 per cent of all growth in the vertical dimension of the jaws is contributed by the alveolar border associated with the growth and eruption of the teeth.[14]

Growth in width and in the anterioposterior directions is also in progress, the former taking place on most of the free surfaces by deposition on the outside and resorption on the inside. The zygomatic arches and lateral walls of the nose are also affected. The mandible is similarly modeled, with an adjustment widening across the gonions through articulation. In the latter or anterioposterior direction length is established to accommodate the molar placements in both the maxilla and mandible by methods previously mentioned, with the addition of a labial modification to meet the larger tooth units in the anterior segment.

The three most rapid horizontal growth periods of the denture, as determined by T. Wingate Todd, are first, from the twenty-first day after birth to the seventh month, at which time the first of the deciduous teeth usually erupts; second, from the fourth to the seventh year. This is a most important age range from the standpoint of the orthodontist, for at this time decisions of great importance must very often be made. Third, from the sixteenth to the nineteenth year, concerning the eruption and placement of the third molars.[15]

Concomitant with these changes there are several areas of growth adjustments which are as interesting as they are necessary. The first is the growth occurring in the condyle to lengthen the ramus for maintenance of the constant plane of occlusion so necessary as the maxillary units grow downward to meet a growth of the mandible just as prolific and upward. Second, the growth and development of the face are augmented by its suspension through the attachments previously mentioned, which are instrumental in carrying it forward and downward through growth of the cranium. Hellman, the late Todd, and others inform us this swing is of greater degree than is the actual growth in a forward direction. Though the face growth is con-

cerned only with the accommodation for the three permanent molars, the growing pharyngeal vault which lies back between it and the cranium must be provided for, and is so, by the entire denture being carried forward. Third, the maintenance of lightness to the upper face as it continues on its journey to maturity is ingeniously taken care of by the growth of the antrum and sinuses; though at birth the antrum was but a fold in the nasal mucous membrane, it gradually enlarges and migrates laterally to occupy most of the bone between the alveolar process and the orbit.

As we pause and reflect on these phenomena we marvel at Nature's desire to establish and maintain the quality of *balance*. This is apparent from the biochemistry of the cell to gross anatomy. Let us, however, be mindful that balance does not always present symmetry. The realm of harmony allows a range of balance with a congruency, if you please, to the variation of the norm as purported by Hellman and others. Conversely, this status of balance may be so influenced by a lack of coordination of the associated forces of occlusion that it does not reach a point of static equilibrium or dynamic balance until five or ten years beyond the normal maturation time, as is often the case in Class II or Class III (Angle) types of malocclusion.

Though this brief description naturally bespeaks a sketchy picture of the developmental growth of the face in relation to the denture on a well-nurtured highway in a state of health, we must be mindful of the works of Krogman[16] and others, showing that "facial growth is particularly susceptible to constitutional inadequacies and aberrances, and that illness in infancy and childhood, allergic upsets, and endocrine imbalances all leave an imprint in the form of an inhibited and unequal growth pattern."

In conclusion, therefore, the complexity of the growth and development of the face and denture may be said to be influenced by metabolic growth processes, functional demands, and extraneous forces.[17] May we become better able to discern true aberrations from those conditions which are but a status in developmental growth. We must no longer think in two planes of space, for Nature works in three, and may our therapy be evaluated by its qualities conducive to such ends.[18]

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309 JACKSON STREET

A REPORT OF TWO CASES OF MALOCCLUSION ACCOMPANIED BY DISTORTION OF THE FINGERS AS A RESULT OF FINGER-SUCKING

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I WISH to present two cases of malocclusion of the teeth which are a direct result of finger-sucking and finger-biting. As a result of these habits of finger-sucking and finger-biting there has arisen a malformation of the affected fingers.

The first case, referred to the orthodontics clinic, was that of a 4-year-old colored girl. Medical examination found her normal physically and mentally. She was very cooperative and eager to help herself.

On examination of her teeth there was found a total lack of occlusion in the right lateral incisor region, the rest of her teeth being in perfect occlusion. As you will note in the photograph, only the right canine and the lateral and central incisors were not in occlusion and were definitely depressed in their sockets. It is interesting to note that there was quite an inflammation in and about the maxillary and mandibular lateral incisor regions. This was evidently caused by the pressure of the finger, or by failure of food to massage the gingival tissues during mastication. The abnormal space between the maxillary and mandibular teeth also caused the child to fall into a habit of forcing her tongue into the space which greatly added to the malocclusion.

In cases where we see that the teeth are in good apposition and can find only one or two teeth out of position, we assume that the cause of this can be traced to some mechanical force, such as lip-biting, tongue pressure, thumb-sucking, holding a pencil between the teeth, sucking on blankets or pillow slips, or as in this case, sucking the index finger.

It was easy to discern, upon examination of this particular child, the cause of this malocclusion. Her right index finger bore two large calluses and was greatly deformed from the sucking habit.

Thanks to the wonderful cooperation of both child and mother, treatment of this case was a simple procedure. The orthodontic appliances in this case were applied to the elbow. At no time during the case were there appliances on the teeth. Orthodontic appliances in this type of case, I felt, were definitely contraindicated because the primary necessity was to remove the cause and if this was not done appliances would be useless. Therefore, the patient was instructed to wear an elbow appliance constantly. This effectively prevented her from placing the finger in her mouth; allowed freedom in playing and in no way caused her the slightest discomfort. Incidentally, the child had also acquired the habit of sucking on the pillow slip. This habit was easily disposed of by the simple expedient of removing the pillows altogether. Added to this treatment the patient was given a minor exercise which consisted of forcing her lip

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down over the teeth at certain specific times during the day. This was given in the hope of restoring the muscle tonus of her upper lip, at the same time guiding the teeth to normal position. This easy treatment was carried out perfectly by the child. The calluses on the finger have almost disappeared and, of primary importance, the teeth have been restored to normal position. At the end of six months the patient was told not to use the elbow appliances any longer as she had completely broken herself of the sucking habit. The teeth are now in normal occlusion, and there is every indication that they will remain in normal occlusion.

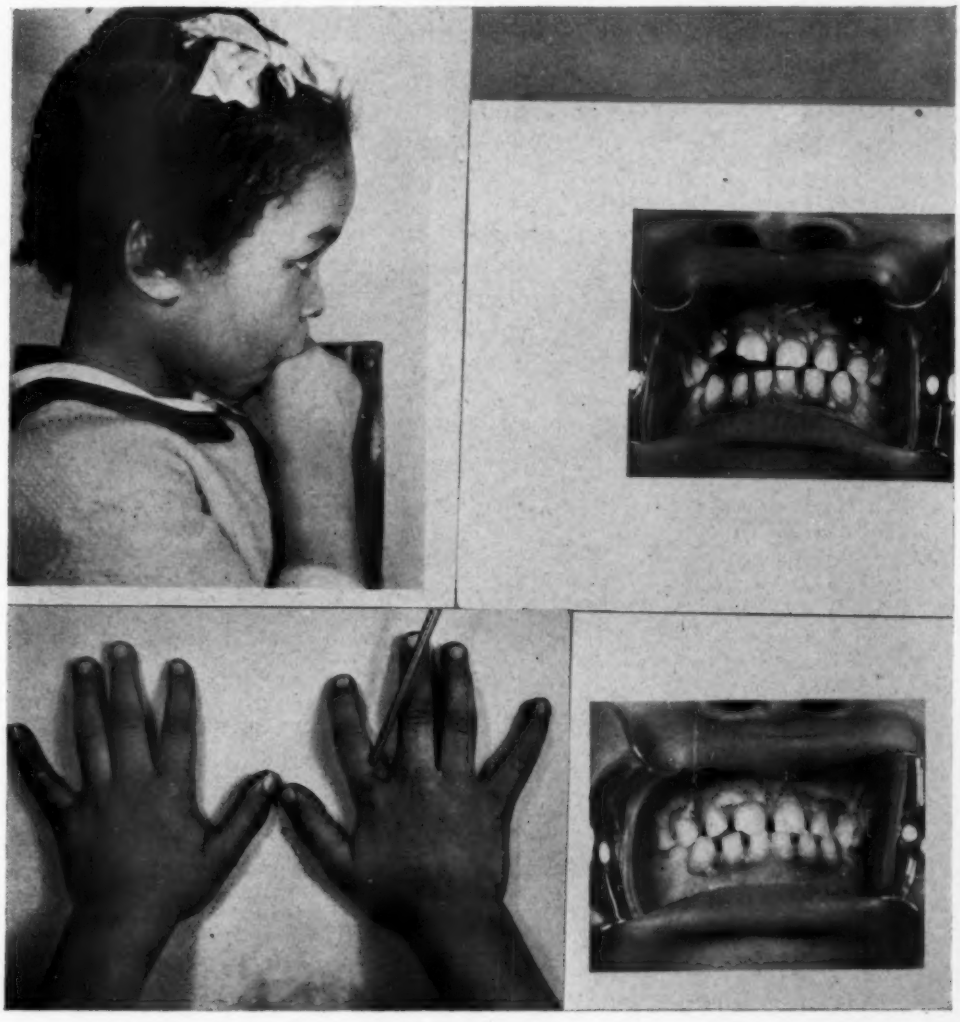

Fig. 1.—*A*, Profile view, showing position of finger during sucking and biting habit. *B*, Position of teeth when at rest. Note space created by the insertion of the finger. *C*, Distortion of the right index finger as compared to the left. Pointer indicates the calluses. *D*, The teeth in normal occlusion after treatment.

The second case is that of a 5½-year-old white girl. The mother had had normal gestation and delivery. The child was breast fed for two months, then placed on S.M.A., received cod liver oil and orange juice during the first year. Medical examination showed a moderately well-nourished, poorly developed, white child. The head was moderately large with prominent parietal

bossae. The supraorbital ridges were enlarged. The maxilla protruded over the mandible one-half inch. All fingers were short and stubby. The curvature of the index finger of the left hand was convex and at the base were two calluses. The child began to suck her finger during infancy after a punishment. Her parent used all types of devices to break the habit, but nothing helped. X-rays of her hands and wrists showed a definite retardation of bone growth and showed bone development of a child of three and one-half years of age instead of five and one-half years of age. This patient was very uncooperative, crying even before she was examined in the dental clinic.

Dental examination showed that her mouth was in a deplorable condition, a lack of personal cleanliness with resultant caries in all her teeth. The mandibular arch was greatly underdeveloped and in extreme distal relationship to the upper arch. This deformity was evident in the facial characteristics of the patient. Due to the deep overbite the child could not enunciate her words correctly.

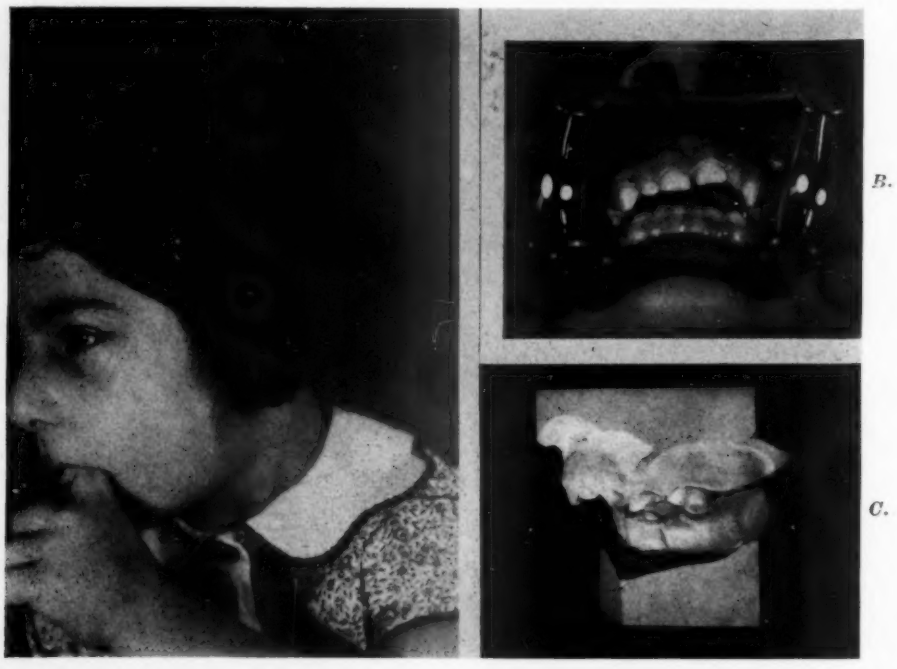

Fig. 2.—*A*, Profile view of patient, showing position of fingers during sucking habit. Note also the calluses on the index finger. *B*, Position of anterior teeth when in the patient's "normal" occlusion. *C*, Side view of models, pencil indicates amount of overbite.

After several visits fairly satisfactory impressions and photographs were obtained. This patient also was a finger sucker, showing two large calluses on her finger which was greatly deformed as a result of the habit. Incidentally in passing let me remark that this particular member subjected to the sucking was the only clean finger on an otherwise dirty hand.

This patient's mother had previously been to a dentist who sold her on the idea of orthodontic appliances. She therefore came to the hospital with that idea in mind and lost no time in informing us as to what treatment was required.

It was explained to her that appliances were not indicated at the present time; the reasons being that the patient still sucked her finger; she was mentally unable to cooperate properly; the teeth were in too poor a condition, and I felt that the encumbrances of orthodontic appliances on the child at this time would not be beneficial to her well-being. An elbow appliance was obtained and the patient and mother instructed in its use. She was given exercises in the hope of developing her upper lip and muscles of her jaws. Needless to say this method did not take well with the mother. The mother was told to bring the patient in for monthly observation but she did not return until the social worker brought her in approximately six months later.

In this elapsed time, the child had developed physically; the facial characteristics had changed. She could grasp things with her teeth, which she could not do previous to the exercises as the mandibular anterior teeth could not reach the maxillary teeth. She enunciated more clearly; mouth hygiene was improved, and the calluses had almost disappeared from her finger. As a final proof that she did not suck her finger any longer, it was no cleaner than the rest.

These changes were evident to all who examined her but the mother. She insisted we were experimenting on her daughter and refused to allow us to make additional impressions or photographs. Evidently during these six months their economic conditions had improved and the mother lost no time in telling us she was going to a good orthodontist who would put braces on her child's teeth at once. Had we been able to continue with this case we would have undoubtedly used orthodontic appliances, but with the natural improvement we were obtaining it would have been more advisable to wait until a later date.

Acknowledgment is made to Dr. S. Cohen for referring Case One to the Orthodontia Clinic.

308 Republic Building

JOHN HUNTER AND HIS NATURAL HISTORY OF THE HUMAN TEETH

BERNHARD WOLF WEINBERGER, NEW YORK, N. Y.

IN 1748 there journeyed to London a rough, uncouth, and ignorant Scotch lad, addicted to low company and amusement and fonder of taverns and theatre galleries than book-learning. It was this lad, John Hunter, who was later destined to bring about decided changes in the medicine of that day. Until then medicine and surgery were considered two distinct professions but with the advent of Hunter, surgery ceased to be regarded as a mere technical mode of treatment and began to take its place as a branch of fundamental medicine, firmly grounded upon physiology and pathology.

Upon reaching London, John came under the guidance and care of his brother, William, ten years his senior. William was in all respects the complete contrast to his brother and had become a distinguished anatomist, surgeon, and accoucher. He was a cultured and polished man of the world and a good classical scholar. John joined him and was employed first as an assistant in the dissecting room. Here he soon found his proper field of activity, and at the end of one year's experience, began to teach anatomy on his own account, while following surgery under Cheselden and Pott. He soon was able to take charge of pupils and to direct their work. Those who studied under him were such men as Jenner, Astley Cooper, Abernethy, Cline, Clifton, Parkinson, Post, and Physick.

In this paper I cannot dwell upon the vast field of medicine that John Hunter was able to alter. His permanent position in science is based upon the fact that he was the founder of experimental and surgical pathology, as well as a pioneer in comparative anatomy, physiology, and experimental morphology. He was likewise a man of science, throwing open the field of surgical observation and experiment to general medicine. He was not content to ask, "How can I best heal this wound?" but "What does the wound signify to the organism?" In this way he passed from the domain of surgery into that of pathology. His anatomic and physiologic studies helped to safeguard him against becoming lost in a maze of speculation.

After obtaining some experience as an army staff surgeon (1761) where he gained his unique knowledge of gunshot wounds, he settled down in London to a life of ardent investigation.

As John Hunter was a composite character, so his work was many-sided, and one senses its magnitude not merely in his writings but in the great museum of over 13,000 specimens which he collected. This museum, now in the Royal College of Surgeons, London, is housed in five great halls where thousands upon thousands of preparations and dissections belonging to the domains of human and comparative, normal and pathologic anatomy are to be found. At his death, the collection gathered by John Hunter was purchased from his executors

by the British Government for £15,000, as he died penniless, having spent all of his own fortune in the purchase of specimens for his collection. Another collection, the Museum of William Hunter, is in the Hunterian Museum of the University of Glasgow. Hunter, however, was not merely a collector of specimens; instead he made it a point to dissect whatever came under his eye, even prior to 1755, for many of the examples he used in his text were prepared at an early age. He wanted to acquaint himself and to understand the organs of the lower animals as well as the human, for anatomy to him must be comparative anatomy, and only through comparison of different species would it be possible for him to understand the general function of life, whether normal or pathologic. He once remarked: "Comparative anatomy is fit only to be read by those that understand a good deal of the human body and the general animal economy, for if they do not understand the standard they cannot understand the variation from it." Again he remarked, "the human body is not a standard in every part for comparative anatomy; for though the brain may be a standard, yet the teeth are not, for they are of the mixed kind in the human; therefore we must either begin with the true herbivorous or carnivorous animals, and the human comes in between."

Besides his museum collection, John Hunter left six masterpieces of medical literature. "The Natural History of the Human Teeth," first published in 1771, was his first but not necessarily his most important work. This was followed in 1778 by the supplement "A Practical Treatise on the Diseases of the Teeth"; a treatise "On Venereal Disease" 1786, which was also translated into many languages; "Observations on Certain Parts of Animal Economy" 1786; the "Treatise on the Blood, Inflammation and Gun Shot Wounds" 1794, and that memorable paper on madder feeding in 1799, to illustrate the manner in which the teeth and jaw grew.

His "The Natural History of the Human Teeth" has been paid a compliment that no other work written in the interest of the dental profession has ever received; written by a physician, and well it deserves this, it has been translated into more languages and has gone through more editions than any other work of which I know. It has appeared in Latin, Dutch, German, French, and Italian. It first made its appearance about the middle of the year 1771, according to the illustrations which bear the imprint "published according to the Act of Parliament May 15, 1771, by J. Johnson." This was followed in 1773 by a Latin and Dutch translation edited and translated by Pieter Boddaert (born about 1730) in Dordrecht. It seems remarkable that this edition has never been referred to by previous authors, nor has there ever been a reference made to its preface. Boddaert's interesting introduction throws considerable light upon Hunter and upon the artists and engravers of the sixteen plates. Boddaert begins with a dissertation as to the value of the bones in the body and then calls attention to the teeth and their importance. He then continues:

> To regard the teeth therefore is more than worth an attentive description, especially regarding their origin, nourishment, use, diseases, and loss. No author, however, as far as known to me, discussed the history of the teeth, although this task would be worthy of the most capable anatomists, until in 1772 when the famous John Hunter, the brother of David and William Hunter, so well known in the history of medicine, undertook this

> task in the English language and performed it so successfully that he earned the highest praise. His work had hardly left the press when everyone was very anxious to read it, not only in England but also in the other parts of Europe. And no wonder, because his clear style gives an exact description and although the reading might be less enjoyable than that which is to be seen, the exact figures lithographed by Charles Grignion—1754-1804, William Wynne Ryland—1732-1783, Sir Robert Strange—1721-1792, and others, supervised by the author himself, and designed by Mr. Riemsdyk, are equal to the clever figures of Mr. Jan Wandelaar—1691-1759, whose reproductions are not second to anyones in anatomic plates, and the artistic value of these reproductions is obvious to every experienced art observer.
>
> Mr. Hunter does not repeat any frequently reported facts nor the generally known or previously described objects but only those details which his zeal and exercises during his leisure hours revealed to him, for this work consists of observations on many bodies from the year 1755 to 1771, the results of which he reported to his famous brother who repeated everything contained in this work in his anatomic lectures.
>
> Hardly did this work become known in Holland through the representatives of art and science, than complaints were lodged that it had not been written in our language (Dutch) because many missed its acquaintance by their lack of knowledge of the English language, and for others the price of the English books was too high. The book dealer, in consideration of this, asked me to translate this book into Latin and Dutch, which I undertook although being apart from the practical medicine for the superbness of the work and the profit which might be expected by the further distribution of this book. So I undertook and fulfilled the translation into both languages and it is up to the experienced reader to judge the result. The Latin of the golden age and the soothing way of telling will be looked for in vain, because of his short way of expression and because of the exact expressions of the author, I was not allowed to enter into the flowery fields of oratory. As far as my knowledge of the English language allows, I followed Hunter strictly. Here and there, I added remarks which ought to have been more frequent, especially regarding the diseases of the teeth and their recovery, had it not been too far away from the original work.

By the use of additional footnotes, Boddaert refers to many of the well-known authors of the period and adds further data to Hunter's observations; some were in accord, while in others he attempts to correct Hunter's statements. Among the authors were Eustachius, Haller, Boerhaven, Meyer, Albinus, Janke, Van Zwieten, Morgagni, Heister, Winslow, Duhamel, and others.

Joseph Fox, a pupil of Hunter, in 1806 stated in the introduction of his famous work: "Mr. Hunter's publication on the teeth was the first scientific book even published upon this subject; and, as an anatomical work, must ever enjoy great celebrity; but not having practically devoted much attention to the operations upon the teeth, there can be no reflection upon Mr. Hunter's merit and standing, that in many essential points he was wholly, but unavoidably, deficient." Fox's criticism is a very just one. John Hunter was an anatomist first and when his works are read in the light of the knowledge of his time, they are admirable. The criticism pertains almost entirely to the second part, written as a supplement between 1771 and 1778 and published in the latter year. Fox probably intended to convey the idea that this work of Hunter's was the first serious scientific presentation of a study of the anatomy of the teeth, and that would be correct. It was not, however, the first scientific work, for

to Pierre Fauchard, who has come to be known as "the Founder of Modern Dentistry," belongs the credit by his "Le Chirurgien Dentiste" published in Paris in 1728. It is hardly likely that Hunter, until after 1771, knew of Fauchard's work, or in fact any of the other dental writers of the period, for his approach and treatment of the subject differ materially from the others, and again it was compiled from data in his own anatomical collection.

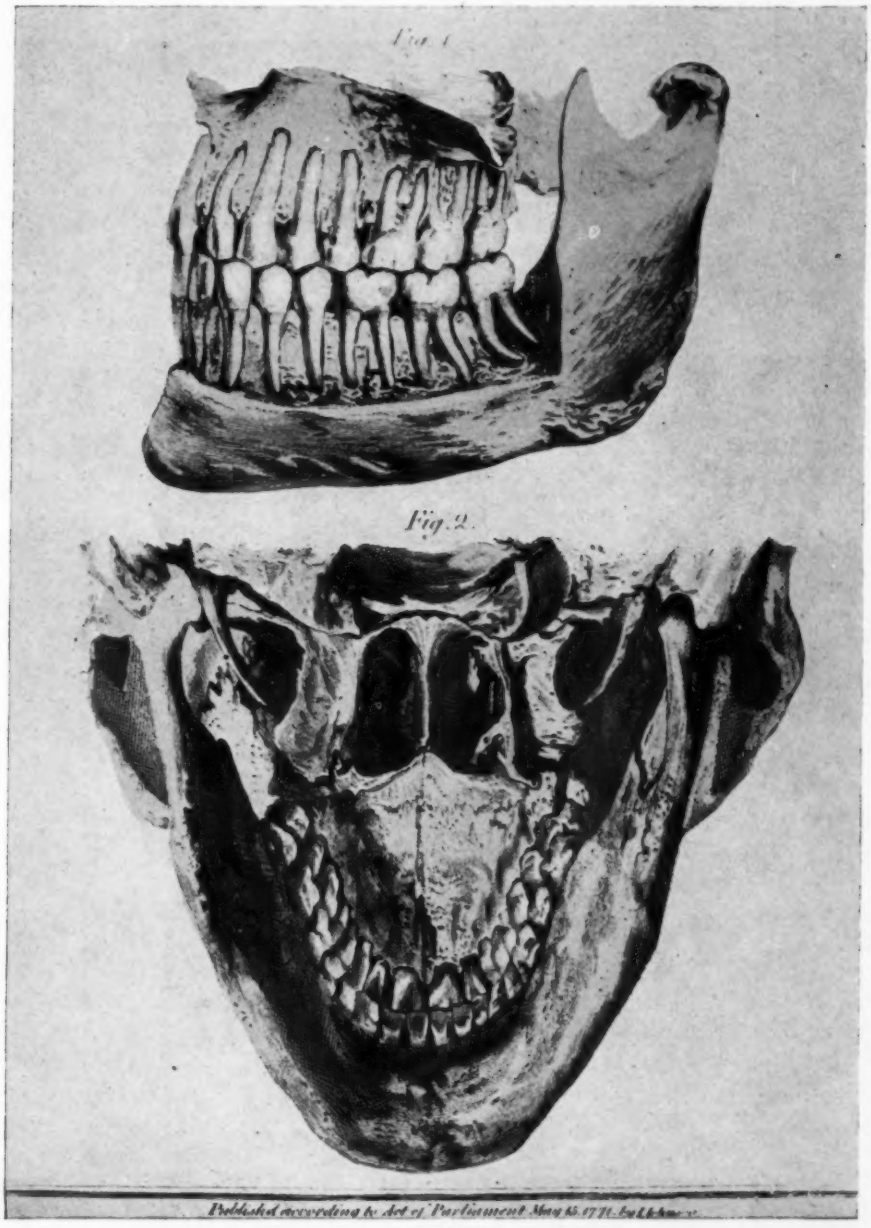

Fig. 1.—*1*, Side view of the maxilla and mandible, with process removed to show the length of the roots and their position in the socket. *2*, A lingual view, with the teeth in contact.

When one reads this work, one must bear in mind, as Sir J. F. Colyer states "to appreciate Hunter's works they must be read in full, and once again it must be impressed that one must try and read them by the knowledge of the time." Many of Hunter's observations, however, still stand today confirmed and unchallenged.

EDITIONS OF "THE NATURAL HISTORY OF THE HUMAN TEETH"

The first edition was entitled "The Natural History of the Human Teeth, Explaining Their Structure, Use, Formation, Growth, and Diseases." London: J. Johnson, 1771. 3 l. 128 pp. 8 l. 16 pl. No index. 26.5 cm. (quarto).

An examination of the sixteen plates shows that they compare favorably with those of Vesalius 1725 edition by Jan Wandelaar, and are distinguished for their beauty and careful preparation. They were not all drawn by the same artists, however, and with the exception of Plate VII there is no way of ascertaining who produced them except from Boddaert's preface in the 1773 edition. This plate was drawn by John Fougeron and engraved by I. Van Riemsdyk. Plate II clearly shows an absence of knowledge of tooth form, in contrast with those on the remaining plates. All of them show that a careful study of each subject was made by Hunter and were taken from actual specimens in his large collection. Plates III and VI, those of teeth in articulation, are perhaps the finest concept of occlusion to be found in any of our anatomic works.

The 1771 edition contains but the first part, and little objection has been raised as to its value. In 1773 this edition was translated by Pieter Boddaert into Latin: "Historia Naturalis Dentium Humanorum"; Latin translation by Boddaert, Petro. Dordraci: A. Blassé et Filium, 1773. 4 l: I-XXII. 1 l. (26.5) 213 pp. And in Dutch: "Naturalyke Histoire Det Tanden Van Den Mensch." Dutch translation by Boddaert, Pieter. Dordrecht: A. Blusse en Zoon, 1773, i-xxii. 213 pp. 26.5.

Though this edition consisted of 213 pages, the even pages are in Latin text, while the odd pages are in Dutch. At the bottom of each page are notes and annotations by the translator; the illustrations are from the original Hunter plates.

In 1778, there appeared two editions, the one I uncovered in 1922 and described in the *Journal of Dental Research*, December, 1924-1926, and the one bearing the imprint on title page, "The Second Edition." The first one mentioned, printed in 1778, was not issued as a copy of the first or second edition, for the type used on each of the title pages differs with the addition of the degree F.R.S. after John Hunter's name on the unrecorded edition. For some time I believed that the copy at the Academy of Medicine was the only one in existence and was just a mistake; however, I have since seen four others. It was probably "a second thousand" of the first edition, though it contains Part II. The first seventy-seven pages are alike and correct in all three editions, 1771 and the two 1778. Pages 77 to 112 of the first part should be in part II and those in part II belong to the first part. Pages 81 to 128 in the second part should be in the first. There are but thirteen plates instead of sixteen and are reversed.

"The Natural History of the Human Teeth; Explaining their Structure, Use, Formation, Growth and Diseases." Parts 1-2. London: J. Johnson, 1778. 2 l. 128 pp. 4 l.; (pt. 2) 1 l., iv, 128 pp. 16 pl. 16 l. 4°. Trial eidtion. Unrecorded.

"A Practical Treatise on the Diseases of the Teeth; Intended as a Supplement to the Natural History of those Parts." London: J. Johnson, 1778, iv. 128 pp. 4°. Forms pt. 2 of his Natural History of the Human Teeth. 2. and trial edition and thereafter.

"The Natural History of the Human Teeth: Explaining their Structure, Use, Formation, Growth and Diseases." 2. ed. London: J. Johnson, 1778. 2 l., 128 pp. 16 pl. 8 l.; (pt. 2) iv, 120 pp. 4 l. 4°. Index. This is the first edition to contain part 2, A Practical Treatise, etc.

In 1780 there appeared three separate translations, one in German: "Natuerliche Geschichte der Zaehne und Beschreibung ihrer Krankheiten." Leipzig: M. G. Weidmann, 1780. 3 l. 296 pp. 8 l. 8 pl. 8°. The natural history is confined in the first 138 pages. The practical part begins on p. 141 and continues to p. 275. Pages 275 to 296 are the description of plates, index pages 297 to 316 additional pages. There are eight re-engraved plates instead of sixteen. Plate 1 contains Fig. 1 of Plate 6. Figs. 2, 3, 4, Figs. 1, 2, 3 of Plate 9. Fig. 5 is No. 20 of Plate 14. 6, 7, 8, Figs. 21, 22, 23 of Plate 14. Plate 2. 1 to 10 is 1 to 10 of Plate 8. No. 11 is Fig. 3 Plate 4.

Plate 3. 1, 2, 3, 4, 5, 6, 7, 8 same numbers of Plate 12. 7, 8 of Plate 12. 9, 19, 11 is 19, 24, 25 of Plate 14.

Plate 4. Figs. 1, 2, 3, 4, are the reverse of Plate 5, rows 1, 2, 3, 4, 5 and 6 and 7, reverse of Figs. 4, 5 and 6 of Plate 9.

Plate 5. Figs. 1, 2, reverse of Figs. 1 and 2, Plate 10. Figs. 3 and 4 reverse of Figs. 1 and 2, Plate 11.

Plate 6. Figs. 1, 2, 3, Figs. 1, 2, 3, Plate 13. Fig. 4, Fig. 1, Plate 15, Figs. 5 and 6, are Figs. 2 and 3, Plate 15. Figs. 7, 8, 9 do not appear in the original but from G. Prochaska.

Plate 7. Figs. 1 to 18, original 1 to 18, Plate 14. 19 Fig. 1. Plate 16, Fig. 20, Plate 16, Fig. 2.

Plate 8. from original Plate 2.

Re-engraved by G. Ender.

There is no clue as to the translator but the footnotes by Boddaert are included, though the title page states: "Translated from the English edition." The others were translated again by Boddaert, but this time printed in the Hague:

"Historia Naturalis Dentium Humanorum; in qua eorum Structura, Usus, Formatio, Incrementium ac Morbi Explicantur atque aeneis Figuris Illustrantur." Anglicae Conscripta a Johanne Huntero, in linguam Latinam et Batavam versa a Petro Boddaert. Hagae: apud J. H. Munnikhuizen & C. Plaat, 1780, xxii, 213 pp. 16 pl. 26 cm. Text in Latin and Dutch, with additional Dutch title page reading: Naturalyke Histoire det Tanden Van Den Mensch.

Practicaale Verhandeling over de Ongemakken der Tanden, Geschikt tot een Vervolg van ed Natuurlyke Historie der Tanden, uit het Engelsch Vertaald Door Pieter Boddaert's Gravenhage: J. H. Munnikhuizen & C. Plaat, 1780, viii, ii pp. 1 l. 66 pp. 26 cm. (4°.)

Hunter: The Natural History of the Human Teeth, Explaining Their Structure, Use, Formation, Growth and Diseases. 3 ed. London: J. Johnson, 1803. 2 l. 246 pp. 20 l. 16 pl. 28.5 (contains 2nd part).

Storia naturale dei denti umani, tradotta sall' inglese da Eleuterio Basile. Milano: G. Silvestri, 1815, 2 l. 108 pp. 21 cm.

Oeuvres complètes de . . Traduites de l'Anglais sur l'édition du D. J. F. Palmer, avec des notes par G. Richelot. Paris: Labé . . 1838-1841. 4 v. 8°. atlas. port. 28 pp. 62 pl. 4°.

The Natural History of the Human Teeth; Explaining their Structure, Use, Formation, Growth, and Diseases. Illustrated with plates. By Eleazar Parmly. New York, 1839. In 2 pts. Am. J. Dent. Sci. i, 1839-40. 56 pages and 46 p. 13 by 21 mm. Though labeled 5 plates, there are 9. John Hunter photo drawn for Am. J. Dent. Sci. as frontispiece.

Treatise on the Natural History and Diseases of the Human Teeth; Explaining Their Structure, Use, Formation, Growth, and Diseases. In 2 pts. With notes by Thomas Bell. Am. Libr. Dent. Sci. i, Phila.: Haswell (et al.), 1839. 127 pp. 8°.

Treatise on the Natural History and Diseases of the Human Teeth; Explaining Their Structure, Use, Formation, Growth, and Diseases, in 2 pts. Phila.: Haswell (et al.), 1839, 127 pp. 8°.

Treatise on the Natural History and Diseases of the Human Teeth; Explaining Their Structure, Use, Formation, Growth, and Diseases. In 2 pts. Select Med. Libr. ed. by John Bell.

CONSIDERATION OF SOME OF THE ODONTOLOGICAL OBSERVATIONS MADE BY JOHN HUNTER

"The Natural History of the Human Teeth," Part I is devoted to the anatomic study of the human teeth and represents many years of painstaking observations and careful study, while Part II, the "Practical Treatise," a supplement, contains the observations on the pathology of the teeth. This supplement is more sketchy and shows a lack of practical knowledge. It is apparent that John Hunter was not acquainted with the literature of his contemporaries and certain phases of dental pathology, for had he possessed such knowledge,

it is obvious that many of the statements made would certainly have been modified. Consequently the first work suffers, for he is generally judged by the second work. It is difficult to determine whether the first part was written especially for dentists. I am inclined to believe that it was intended as an answer to many of his contemporaries for their careless presentation of the anatomic theories then being advanced; at any rate, even to this day it is without a doubt one of the finest sources of knowledge of dental anatomy.

The first ten sections or thirty-two pages are devoted to an account of the anatomy of the maxilla and mandible, the muscles of mastication with their function in the complex movement of the mandible. Hunter begins his work with a description of the jaws, giving more attention to the lower than to the upper. His observations of the mastication with their function in the complex movements of the mandible are correct all the way through, especially those on the alveolar processes which, as he points out, are transient structures belonging more to the teeth than to the jaws and which are affected by the diseases of the teeth and suffer ultimately their fate. This description of the mutual dependence of the teeth and alveolar processes is strictly correct and beautifully presented, and it should be read by all, especially that part which relates to the condyle and glenoid fossa, for much may still be learned from it.

The next, or eleventh, section deals with the structure of a tooth and of the enamel. Here the nature of the enamel is considered and the arrangement of its fibers described. The twelfth section deals with the bony parts of a tooth.

Hunter, after long and very ingenious investigations covering practically all the range of the animal kingdom that has teeth, finds them to be composed of two tissues, namely, enamel and bone. Today we know bone as dentine and we add two more tissues found much later through microscopical studies, namely, Nasmyth's membrane, or enamel cuticle, which is external to the enamel, and the very important and extremely thin cementum which covers the root. He mentions the very richly vascular dental pulp and notes that its nerve supply is apparently out of proportion to its importance, a fact which has been the cause of much suffering. The pulp chambers and the apical foramina in the various teeth are described in detail. Of the structure of the enamel he notes that it is inorganic with a very small portion of animal substance, that it is not vascular and apparently nonvital, which is all strictly correct. Of the dentine or bony structure, as he calls it, he notes that it is much more compact than any bone, that it is also composed of inorganic salts but contains more animal substance than enamel, and that this organic substance seems to be organized and vascular. He arrives at this conclusion in a very admirable way by feeding young pigs with madder in a series of experiments which have become a classic of studies in bone growth, and which I will consider later.

Section thirteen treats "Of the Cavity of the Teeth," while fourteen "Of the Periosteum of the Teeth." He says: "It appears to be common to the tooth which it incloses and the socket which it lines as an investing membrane." He was later to be attacked for this statement but modern dental science appears to vindicate him.

The teeth were commonly divided by Hunter into three classes, the incisors, cuspids and grinders or molars. He wrote, in "considering some circumstances of their form, growth, and use, I choose to divide them into the four following classes, viz., incisores, commonly called fore teeth; cuspidati, vulgarly called canine; bicuspides, or the two first grinders, and molars, or the three last teeth." In this he again showed the way, except that we have adopted the term "premolars" instead of the long prevalent bicuspid as being more exact. After this classification there follows a very detailed description of every tooth in each class, sections seventeen to twenty.

It is in these sections that Hunter refers to those beautiful drawings, Plates 3 and 6, of the relationship of the individual teeth of the upper to the lower. These plates present the finest conception of occlusion given to the dental profession and that dates back prior to 1771.

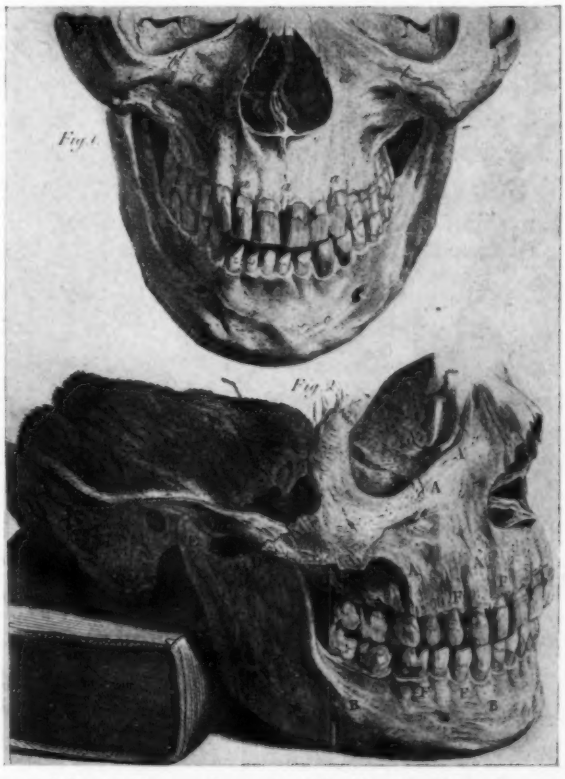

Fig. 2.—*1*, A front view of the full complement of teeth. 2, Side view, with the teeth and occlusion.

I will pass over some very interesting and accurate sections on the articulation of the teeth, section 21, which is a model of clarity and conciseness, but will note in passing the compact and well-to-the-point definition: "The fangs of the teeth are fixed in the gum and alveolar processes, by that species of articulation called gomphosis, which in some measure resembles a nail driven into a piece of wood." Also a section on the gums, 22, which he notes "is very vascular but seems not to have any great degree of sensibility." Both these observations are strictly true and of very important practical value, and probably he was one of the first to direct attention to them.

In Section 24, general comparisons are made between the motion of the jaw in young and in old people. The center of motion of the jaw in both young and old people is shown to be in the condyles. "In children who have no Teeth there does not seem to be a sliding motion in the Lower Jaw," owing apparently to the nondevelopment of the articular eminence. In this chapter, Hunter makes the important observation that "in proportion as the last Grinders are produced, the sides of the curve formed by the Jaws become longer and push forward the fore-part, none of the additional part passing backwards. The fore-part also continues nearly of the same size, so that the whole Jaw is longer in proportion to its breadth, and projects farther forwards."

Section 25 deals with "the formation of the alveolar process," the development of which is traced from the fetus to the adult. Section 26 gives an account of "the formation of the teeth in fetus." In a few words, Hunter tells the story of the ossification of the teeth in a manner so accurate and clear that it has never been improved on. He shows how ossification of the "five little pulpy substances" in the fetal alveoli begins at about 5 months, first "on the edge of the first Incisors." And he makes the observation, scarcely known to modern students of the subject, that, at this age "the Cuspidati are not in the same circular line with the rest (of the teeth), but somewhat on the outside, making a projection there at this age, there not being sufficient room for them." He continues: "In the sixth or seventh month, the edges, or tips, of all these five substances are begun to ossify, and the first of them is a little advanced; and besides these, the pulp of the sixth Tooth has begun to be formed; it is situated in the tubercle of the Upper Jaw."

Section 27 deals with "the cause of pain in dentition." The profound accuracy of Hunter's observational powers as displayed in this chapter leaves one astonished, for it was not until 1924 that Prof. Cyril West made an independent demonstration of Hunter's statements with respect to the vascularity of the gum over an erupting tooth. Hunter writes as follows: "The Teeth, when they begin to press against the Gum, irritate it, and commonly give pain. The Gums are then affected with heat, swelling, redness, and the other symptoms of inflammation. The Gum is not cut through by simple or mechanical pressure, but the irritation and consequent inflammation produces a thinning; or wasting of the Gum at this point. . . . Since the Teeth are to be looked upon as extraneous bodies, with respect to the Gum . . . there can be no doubt of the propriety of opening the way for them."

These interesting and absorbing sections on the development and growth of the human dentition have always been one of much speculation and the object of much research; needless to say they are very complex. I believe Hunter was the first to study this subject in a scientific way, and his observations put an end to many fanciful notions. He shows accurately the time when the alveolar processes begin to form and when the tooth germs begin to function; also when the calcification begins and where the various centers of ossification are in the various teeth; throughout, the mode of calcification is lucidly described. Some of his views are of course not accepted in the light of the present knowledge, especially those on the formation of enamel and dentine, but his general observations, such as the time of calcification and eruption, are

correct, and we must also remember that Hunter never used a microscope. He was also the first to point out that the permanent teeth develop in distinct, separate alveolar crypts, that they do not push out the deciduous teeth but that they supply a necessary stimulus in their eruption, "whatever it is; and, rightfully, their formation and appearance proceed not regularly from the first incisor backward to the dens sapientiae, but begin at two points on each side of both jaws, viz., at the first incisor and at the first molaris. The teeth between these two points make a quicker progress than those behind." And it is a tribute to Hunter that a modern observer says, "His views regarding the development of the jaws are practically identical with the views accepted by anatomists of the present time."

In Section 28, the "formation and progress of the adult teeth," in their relation to the temporary teeth and their alveoli are considered. In Section 29, "the manner in which a tooth is formed" is described, and an account is given of the periodontal membrane.

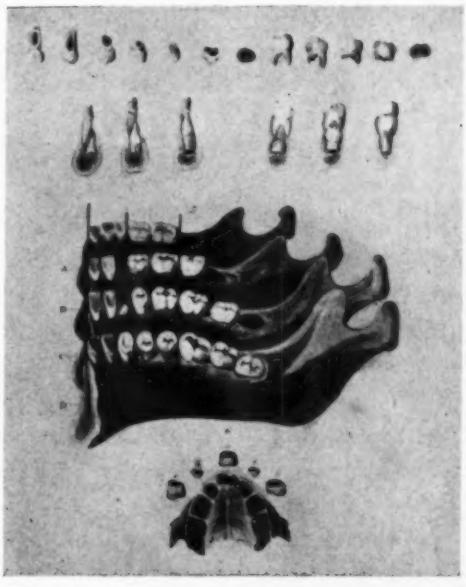

Fig. 3.—Drawing from Joseph Fox, 1806 edition, giving the same idea of growth as Hunter, except that the teeth have been more carefully drawn. It represents four mandibles at different periods of life, from the age of 5 years through the period of the eruption of the third molar.

In Section 30, the "ossification of a tooth upon the pulp" is most succinctly described, and, in Section 31, the "formation of the enamel" is dealt with. In Section 32, "the manner of shedding of teeth" is discussed, and the old error which attributed the shedding of the temporary teeth to the pressure above them of the permanent teeth is disposed of.

In Section 33, "the growth of the two jaws" is considered. Here, Hunter points out what has since by much labor been confirmed, and was the first to show by simple comparison of four half-jaws how the mandible grows at the posterior border. His original drawing is Fig. 16, and in an oft-quoted passage, this is what he says:

> The jaw still increases in all points till twelve months after birth, when the bodies of all the six teeth are pretty well formed; but it never

> after increases in length between the symphysis and the sixth tooth; and from this time, too, the alveolar process, which makes the anterior part of the arches of both jaws, never becomes a section of a larger circle, whence the lower part of a child's face is flatter, or not so projecting forwards as in the adult.
>
> After this time the jaws lengthen only at their posterior ends; so that the sixth tooth, which was under the coronoid process in the lower jaw, and in the tubercles of the upper jaw of the foetus, is at last, viz., in the eighth or ninth year, placed before these parts; and then the seventh tooth appears in the place which the sixth occupied, with respect to the coronoid process and tubercle; and about the twelfth or fourteenth year the eighth tooth is situated where the seventh was placed. At the age of eighteen or twenty, the eighth tooth is found before the coronoid process in the lower jaw and under, or somewhat before the tubercle in the upper jaw, which tubercle is no more than a succession of sockets for the teeth till they are completely formed.

This also was the first effort at superimposition to demonstrate growth changes. But Hunter was not satisfied with mere comparison; he proceeded to prove his supposition by experiment, using the method of madder-feeding, the results of which had been first described by Belchier in a communication to the Royal Society, in 1736, although there is evidence that the effect of madder on the bones had been known at least from the sixteenth century. Hunter was preceded by Duhamel in the use of this method for the detailed study of the growth of bones.

When madder is added to the food of animals, all new bone formed during the period is colored by the dye, to which the calcium phosphate of the bone is supposed to act as a sort of mordant; the bone formed during a given period can thus be readily distinguished. By this means John Hunter satisfied himself that his opinion on the growth of the mandible was correct; but he did more than this. His general investigation of bone growth by this method led him to verify the principle of the growth of bone in thickness by surface addition beneath the periosteum, a principle which Duhamel had stated in 1740, but at the same time Hunter denied the occurrence of expansion or interstitial growth of bone in which Duhamel also believed. In spite of the evidence, to which he himself was the first to call attention, of surface addition as the true mode of increase of the thickness of bones, Duhamel believed that only interstitial growth or expansion of bone could explain the alteration in the situation of the ring in his well-known experiment. In this experiment a ring of wire, being placed round the long bone of a growing pigeon under the periosteum, is found later with the growth of the bone actually in the medullary cavity. Hunter, with the evidence of the growth of bones in thickness by surface apposition before him, did not believe in the possibility of interstitial growth; he came to the conclusion that the medullary cavity of a long bone enlarges by absorption from within, the ring reaching the cavity by this means combined with external addition, and not by cutting through the bone as a result of interstitial expansion as Duhamel supposed.

But Hunter also discovered the still more important fact that absorption takes place also at the external surfaces of bones. Now this is a conception of fundamental importance, and he applied it not only to the long bones, in which growth in length is accompanied by absorption near the ends so that the general

shape of the bone is always retained, but also to the mandible. Hunter thus gave us the fundamental truth about the growth of the mandible, that it increases behind by additions to the posterior border, while the ramus including the processes is at the same time remodeled by a cutting away of the front of the coronoid and to a lesser extent of the condyle; in addition to the retention of the shape of the bone, room is thereby provided for the developing molars, which in succession make their appearance on the inner side of the root of the coronoid.

John Hunter seems to have believed that alveolar growth accounts for the occasional rising of single fully erupted teeth when unopposed. "The teeth would probably project a little further out of the gum," he says, "if they were not opposed by those in the opposite jaw; for in young people who had lost a tooth before the rest had come to their full length, I have seen the opposite tooth project a little beyond the rest before they were at all worn down. It may further be observed, that when a tooth is lost, the opposite one may project from the disposition of the alveolar process to rise higher, and fill up at the bottom of the sockets; and the want of that natural pressure seems to give that disposition to these processes. . . ." And again, "yet commonly in these cases the tooth continues to project further and further through the gum, though this is not owing to its growing longer, but to the socket filling up behind it, and thereby continuing to push it out by slow degrees."

Section 35, "on the cavity filling up as the teeth wear down," gives the first description of the formation of secondary dentine.

In Section 36, Hunter, dealing with the alleged "continual growth of the teeth," shows that the teeth "grow at once to their full length, and that they gradually wear down afterwards; and that there is not even the appearance of their continuing to grow."

In Section 37, on "the sensibility of the teeth," Hunter traces the origin of the pain to the nerve in the cavity of the tooth, and the peculiar intenseness of dental pain, "as well as the quickness of the sense of heat and cold in Teeth," suggesting that the latter may be "owing to their communicating these to the nerve sooner than any other part of the body."

In Section 38, "supernumerary teeth" are discussed. "The use of the teeth, as far as they affect the voice," is discussed in Section 39, and it is shown that the fore teeth play the most important role, when they are lost, in bringing about alterations in the voice.

In Section 40, the question is asked "Under what class do the human teeth come?"

Section 41 consists of a short general discussion of "the diseases of the teeth," in which most pain is said to arise "in a great measure from the air coming into contact with the nerve in the cavity of the Tooth." Caries and the mystery of its origin is next considered, and the filling of the teeth with lead, wax, etc., advocated, when possible, in order to allay pain and retard decay.

Section 42 deals with the "cleaning of the teeth," in which the modern method of prophylaxis is advocated.

The final section 43, is concerned with the "transplanting of teeth," in which it is shown that the teeth of one individual may be successfully transplanted in the jaw of another.

With this chapter, the first scientific treatise, constituting as nearly a complete and original analysis of the human dentition as has ever been made, and representing one of the great landmarks of scientific progress, is brought to a close.

It will be impossible to consider the second part on account of lack of time. I do want to mention, however, Chapters VI, VII, and VIII which deal with what comprises today the domain of orthodontia, namely, the abnormal positions of the teeth. These are very interesting chapters and full of accurate observations and sound advice as to regulation, with emphasis on moderation. Today most of Hunter's observations have been shown to be correct and the present treatment does not differ very much from what he suggested.

I do not believe I have adequately treated a subject that deserves far greater consideration. Hunter's work was one of the brilliant milestones in the history of dentistry, written by a physician who had made a thorough study of a subject hardly known at the time. The remarkable part is to note the keenness of Hunter's observations and how many of those made over two hundred years ago are still to be found correct and are the basis of our present theories, and yet we believe we can learn little from a study of history.

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119 WEST FIFTY-SEVENTH STREET

CHILDREN'S BRIDGEWORK PREVENTS CROOKED TEETH*

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THE purpose of this radio talk is to offer an evangelistic object lesson in dental health education. As it is customary to quote a text for every sermon, the preachment of mine will be, "The value of prevention over cure." The most important facts to be borne in mind are that diet and the home care given to cleanliness are most necessary to help preserve the teeth and keep the mouth in a healthy condition. The next important point to remember is that the child's masticating apparatus can be preserved by periodic inspection several times yearly. If teeth need attention, it is better to preserve them by filling small holes than to allow the cavities to become larger, because when too large, often they cannot be filled safely. To have them pulled causes complications in the position of teeth and the biting together of teeth in opposing jaws. This applies alike to baby teeth and to second teeth. So in selecting the topic "Children's Bridgework Prevents Crooked Teeth," it is my desire to point out the value of one particular phase of preventive dentistry, when baby teeth have been lost through decay or through accident. The rendering of such a service has its place in dental practice and the use of this form of artificial replacement when properly indicated in the child's mouth will prove of inestimable value to the child during his various periods of growth and development. It is during such times that we must be especially watchful of the child. There are many influences in the body which stimulate these processes. Physicians and dentists are learning more and more about them so that proper advice and skillful guidance during such periods of readjustment are now available.

It is inevitable that the child grow up to be an adult. During childhood and adolescence, the transition stages which precede maturity, many changes take place in the body. These transformations are gradual and steady. Nature goes on its way making alterations and additions to fit each child for its future role of manhood and womanhood. While these modifications progress, the face develops with the rest of the body, as do also the teeth and the bones which carry them.

During the transition from infancy to the adult stage of life, the entire skull develops; the upper half or the cranium increases four times its early size and the lower half or the face is similarly multiplied twelve times its bulk. It is because of this growth that the necessity has arisen to insure the proper positioning of teeth while these changes take place. If there is any disruption of tooth continuity, if any tooth is lost either accidentally or through measures taken to protect the health of the child, nature in its kind way tries to compensate for the deficiency. It usually does so by a shifting and a tilting movement of the remaining teeth, whereby an attempt is made

*A radio talk given in San Francisco over station KLX in 1936, during the American Dental Association meeting.

to fill in the space caused by the loss of any intervening tooth. This phenomenon is the result of growth influences; the face grows forward, outward, and downward and the jaws develop in the same directions at the same time. These influences cause teeth to drift out of position. The cranium and the face growing at different rates and in different directions will give the adult a completely different appearance from that same individual if observed continually from the time of birth, through adolescence to maturity.

It is to protect the health and also the pleasing appearance of the child that the dentist has been prompted to develop ways and means whereby both may be maintained. Unfortunately many influences tend to deflect nature from its proper course. Among other causes in these days of civilization with its many inventions, the most common in universal use is the automobile. Speed, and then more speed, is the usual thing. Naturally we are all good drivers, some of us better than others; it is the other fellow of whom we must be watchful. In watching the other fellow, we are often face to face with the necessity of throwing on our brakes suddenly and coming to a sudden halt. We must avert an accident and save not only our own lives but those of others. There has been no crash; we have certainly avoided that fool driver who flirted with our lives. But in so doing we have all been thrown forward by the sudden stop of the car. In the next moment when the hysteria of the shouting has died down, we still hear the cry of our youngest daughter, aged 4 years. We look and we see the child's face is besmudged; the bleeding is profuse; the lip is cut slightly, but when we finally ease her cries, we realize that the four upper front teeth are missing and perhaps, to make matters worse, one or two of the lower ones also. Our first thought is to seek a physician promptly to assure ourselves that no further injury has been done. Once we have received his assurance we feel satisfied and usually nothing else is done about it. The teeth are lost; the child will soon get others. We feel satisfied that we must be thankful that no greater damage has been done. It is then that the parents should consult with the dentist.

The dentist will say to you, "Mrs. Jones, something should be done right now for that growing child. She will soon enter into a developmental period of her life during which important changes take place in her mouth. The small baby teeth will be replaced by the second teeth. The mouth must grow to accommodate them. If you permit the child to continue without teeth for any great length of time, there may be a collapse of the teeth which remain, so that those which follow may not have room to come into their proper places. Of course, this does not happen always, but I know that if I place something in that mouth to maintain the space caused by the loss of the teeth, those which will come in later will have room to grow into their proper places. We advocate a bridge for the child with a device in it which will allow the bridge to spread as the jaws develop in width. This growth is usually a natural sequence so that the larger teeth which are to come will have plenty of room to find their proper places alongside of one another. We prefer to make a bridge because it is cleaner than a device made of gold spanning wires which will also hold the teeth in place. Then, too, your child will look much nicer because teeth will take the place of the wide open space. The arrange-

ment in the bridge will prevent the collapse of the remaining teeth toward the center line, thereby preserving the room which should be reserved for the larger teeth which follow later. Your child will eat much better because this bridge will permit her to chew well, and she will talk much better too.

"Speech is a very important point to consider. If you don't know about it, I should like to tell you that the front teeth are very important in forming certain letters of the alphabet. The letter C is pronounced by hissing the air from the mouth through the front teeth. The letter D is a tongue and teeth sound, the tongue being pressed hard against the upper front teeth at the gum line and the front part of the hard palate, and then withdrawn to finish the sound. The letter L is formed somewhat similarly except that the tongue is placed slightly farther back and the air is forced from the throat. In forming the S sound, the air is blown over the tongue and through the front teeth. The letter T is a tongue and teeth sound, the tip of the tongue being placed at the back of the front teeth and the air being blown through them. So you see, if these lost teeth are not replaced, there might be a serious impediment in speech. That in itself is sufficient cause for the placement of a bridge. Another thing that this upper front bridge will do is to prevent the lower teeth from growing upward into the gums which they will do if there are no teeth in the vacant space to hold them back. This biting of the lower teeth into the upper gums has a tendency to make the upper teeth grow forward when they eventually come into the mouth. A mouth with the upper teeth placed greatly forward and the lower teeth placed a distance behind the upper teeth does not look well. It also prevents proper chewing and might eventually loosen the teeth in adult life due to constant and heavy pressure. In other words, I am trying to show you that not only will you prevent the teeth from becoming crooked but also you will maintain the mouth in a state of health thereby insuring the proper function of those teeth until such time as nature can take care of the condition without an artificial substitute or further observation by the dentist. Regarding the lower teeth, much the same reasons might be given for a bridge of that type, so there is no need to go into all the virtues of such dental work.

"Of course, I believe that if you take your child to the dentist at regular intervals as he directs, all baby teeth can be filled when the cavities first appear, thereby preserving them until their permanent successors come into place. You should always remember that the big back grinding teeth which your child gets approximately between the fifth and the sixth year of age come into a mouth just once, and without the loss of any baby tooth as is the case with others of the second set. These first permanent molars, so-called 'six-year' molars, should be watched with the greatest care as they are the most important teeth in the mouth. Their position is to the rear of the last baby teeth, upper and lower, right and left, the sixth tooth back from the center line. They are called the keystones of the dental arch, all other teeth of the second set being guided into their positions by the first permanent molars. Therefore give them special care.

"It does happen sometimes that even with the greatest care some baby teeth must be extracted as a health measure. When front teeth are lost, sub-

stitutes may be supplied in a manner of which I have spoken. However, I should like to tell a bit about a bridge in the back of the mouth if your child should happen to lose one of his baby molars. The back teeth may also be replaced by a bridge. By placing a bridge in the back of the mouth, the other back teeth will be prevented from leaning forward and drifting forward to take up the place of the tooth which will succeed the one which has been prematurely lost. The bridge will thereby prevent the crowding of the remaining teeth into the space created by the loss of the tooth; it will maintain the space for the proper placement of the second teeth; it will help your child to chew well, and it will prevent the tooth in the opposite jaw from growing downward into the space which may happen because there is nothing below it to stop it.

"Mrs. Jones, I have spoken at great length to you this morning, but I feel that it has been time well spent. I hope that I have, from a dental viewpoint, helped to impress upon your mind the value of the old adage, 'An ounce of prevention is worth a pound of cure.'"

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Edited by

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THE SURGICAL TREATMENT OF ABNORMALITIES OF THE EDENTULOUS ALVEOLAR PROCESSES AND THE PALATE

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THE purpose of this paper is to describe several operations which facilitate the successful making of efficient dentures. Of these, the operations described as "ridge extension" are explained in detail. Since 1918 hundreds of these operations have been done in our clinic, and have facilitated the work of our colleagues who have later constructed the dentures. In conceiving these operations, the author has been impressed not only with the effectiveness of the operation but with the difficulty he has had in describing to others the technique of the operation, which, so far as can be determined, is original. These operative procedures are not difficult, however, once the principles are understood.

Oral structures undergo constant changes throughout life. The teeth and their supporting structures may be affected by disease or trauma. Even in edentulous mouths a slow but constant change takes place and often creates difficult problems for the prosthetic dentist. Unfortunately, preventive dentistry has not made enough progress as yet to make the use of prosthetic appliances unnecessary. Most of us, sooner or later, must depend on artificial dentures to masticate food. The efficiency of these dentures depends largely on the skill of the prosthodontist, provided that the general outline of the alveolar ridges and the conditions of the soft structures of the mouth have the necessary requirements for the support of the denture.

Until recent years, no serious attempt was made to prepare the mouth surgically. Dentists largely depended on their skill to overcome various handicaps. However, even as early as 1876, W. George Bearse of Montreal, Canada, conceived the advisability of judicious trimming of prominent alveolar processes following extraction of the teeth.

For many years before the use of x-rays, the accepted surgical procedure consisted of extraction of teeth without regard to pathological conditions at their apices. Often it was necessary to wait months for the mouth to heal before a denture could be supplied. Not infrequently, roots of teeth were left in posi-

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tion and dentures fitted over them. Of course, to the contemporary student of dentistry, these procedures seem astonishing but one must remember that appreciation of the danger of focal infections did not exist then. With the advances in oral pathology, surgical technique has made corresponding progress.

It was soon realized that in addition to removing pathologic tissue, it was also possible to take surgical measures to shorten the period of convalescence and to improve the contour of the alveolar ridges. Normally, when the teeth are removed, changes follow which influence the contour of the alveolar ridges and the depth of the buccal groove. There is the usual amount of resorption of the alveolar bone, which is physiologic and desirable, as it gives sufficient space for the placement of artificial dentures. However, under certain conditions there may be either too much *resorption* or excessive *hypertrophy* of the alveolar tissue. In the first instance there results a flat ridge, while in the second case there will be protrusion of the alveolar ridges. When either condition is present, the construction of esthetic looking or stable dentures is greatly handicapped. Several factors contribute to the excessive resorption of the alveolar ridges: First, pyorrhea alveolaris causes destruction of alveolar bone long before the teeth are removed; second, major pathological conditions, such as osteomyelitis and various tumors and cysts, invariably affect the contour of the bony structure of the jaws; third, acute ulcerative lesions such as necrotic stomatitis may cause extensive loss of mucous membrane, eventually replaced by scars and adhesions; fourth, traumatic lesions such as fractures of alveolar bone either by accident or by operation for the removal of teeth invariably leave their after effects; fifth, ill-fitting dentures, or dentures that have been used long after the mouth condition has changed, are the cause of many abnormal conditions seen in the edentulous mouth. In this respect there is often excessive resorption of alveolar bone especially in the anterior region and replacement with hyperplastic flabby mucous membrane. In other words, constant irritation at the borders of the denture appears to stimulate the formation of redundant tough fibrous tissue which is a handicap to the construction of efficient dentures. At this point it is interesting to note the findings of Pendleton and Glupker in their microscopic studies of edentulous patients. They have concluded that "The original reaction of the supporting tissues to full dentures is influenced by the unequal distribution of functional stresses resulting from acquired habits of mastication. Areas of hyperplastic tissue indicate resorption of bone and are found in regions diametrically and diagonally opposite to the areas subjected to positive force. Tissues subjected to 'negative forces' usually show a reaction that indicates a degenerative and inflammatory process."

In addition to the above-mentioned local causes of changes in the structure of alveolar bone, there are undoubtedly some constitutional factors as yet not very well understood, that affect the metabolism of the alveolar bone. McKevitt emphasizes the importance of the rate of parathyroid activity, which causes hypo- or hypercalcium condition of the bone. We know that debilitating diseases, such as pernicious anemia, have an influence on the general metabolism of the body cells. In addition to these unfavorable factors we see frequently many developmental abnormalities which are not pathologic, but whose pres-

ence is not favorable for the construction of serviceable and esthetic looking dentures. These may be summarized as follows: overprominent alveolar ridges; exostoses of various parts of the palate and mandible; and hypertrophy or atrophy of the soft tissues of the alveolar process and palate.

The operative procedures I am about to discuss would probably be understood more clearly if we make a brief anatomic review of the tissues that determine the outer boundaries of the normal gingivobuccal and gingivolingual folds. These boundaries are normally determined by the attachment of certain muscles of mastication and expression. Their attachments on the buccal, labial, and lingual surfaces of the mandible and maxilla mark the beginning of mobile and active tissues. It is therefore important to have a comprehensive knowledge of

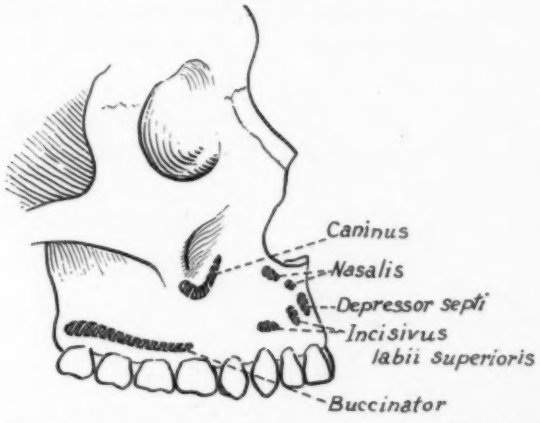

Fig. 1.—Diagram showing the attachments of the various muscles of the dentulous maxilla which influence the outline of the buccal fold.

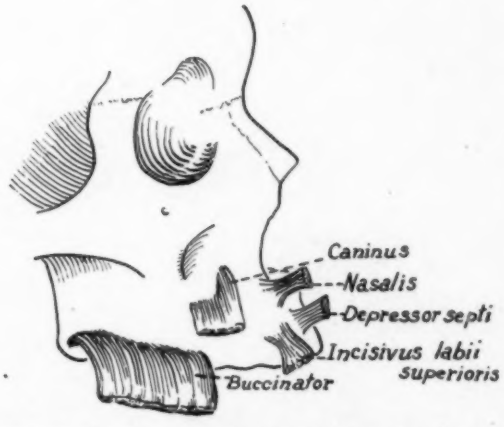

Fig. 2.—Diagram showing the attachments of the various muscles of the edentulous maxilla.

the various tissues with which we are dealing, especially the position of some of the muscles nearest to the alveolar ridges. The most important is, in the maxilla, the buccinator, which is attached to the tuberosity and the buccal plate of the alveolar processes of the maxilla opposite the molar teeth, and thus influences the boundary line of that area. The other muscles which make the anterior boundary are the compressor nasi and depressor alae nasi, the caninus and incisivus labii superioris. In edentulous maxillae the borders of the dentures are trimmed to harmonize with the attachments of these muscles (Figs. 1 and 2).

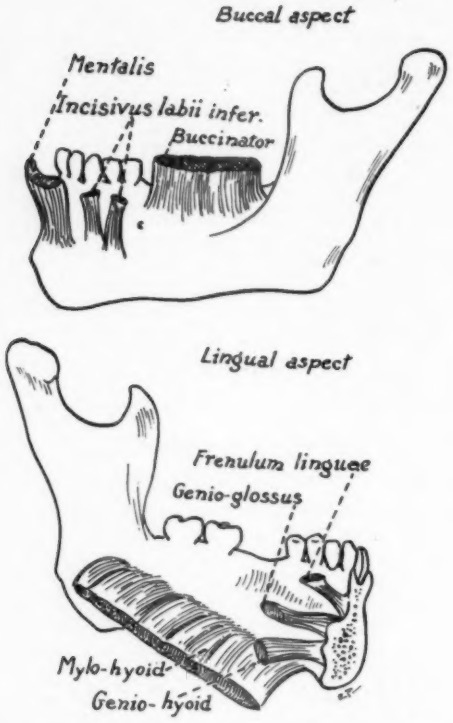

Fig. 3.—Diagram showing the attachments of the various muscles of the dentulous mandible which influence the boundaries of the alveolar ridge.

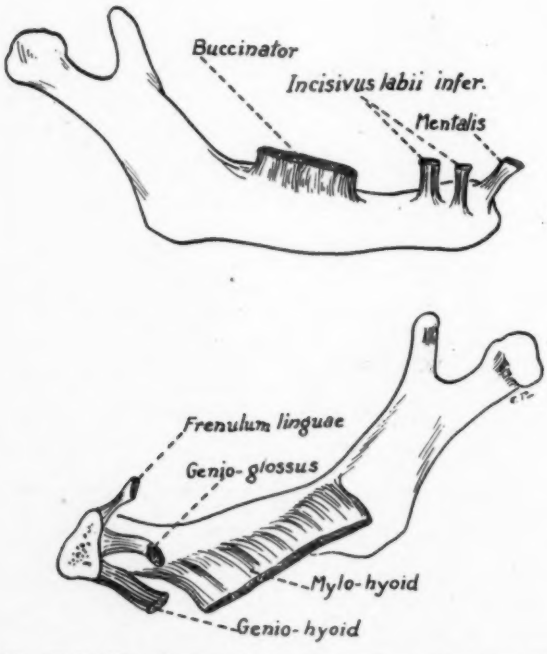

Fig. 4.—See Fig. 3. Note the change that takes place when the teeth are absent.

In the mandible, the mentalis and the depressor labii inferioris form the principal boundaries in the anterior part. The muscles attached to the lingual surface and which influence the extension of the lingual borders of the lower denture are: the mylohyoid, a few fibers of the buccinator muscle at the molar region, the genioglossus, the geniohyoid and the frenum linguae (Fig. 3). Due to absorption of alveolar bone the attachments of these muscles often are nearer the center of the ridge, leaving very little space for the denture (Fig. 4).

PREVENTION OF DEFORMED ALVEOLAR RIDGES

Before entering into the discussion of various operative procedures for preparing unfavorable mouth conditions for dentures, I should like to emphasize a few points which may aid to prevent them:

(1) I think it is conducive to serviceable supporting bony structures if teeth that are hopelessly involved by pyorrhea are extracted before too much bone has been lost.

(2) Greater care should be exercised not to traumatize the tissue in the process of removing teeth. A careless fracturing of alveolar bone or needless laceration of mucous membrane will eventually do considerable damage.

(3) Except in rare occasions no mucous membrane about the gingival margin of the alveolar processes should be sacrificed when removing teeth. It will be shown later that after trimming even a prominent alveolar ridge the excess mucous membrane may be utilized in the extension of the gingivobuccal fold.

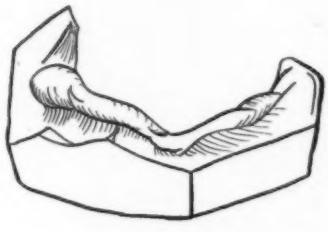

Fig. 5.

Fig. 6.

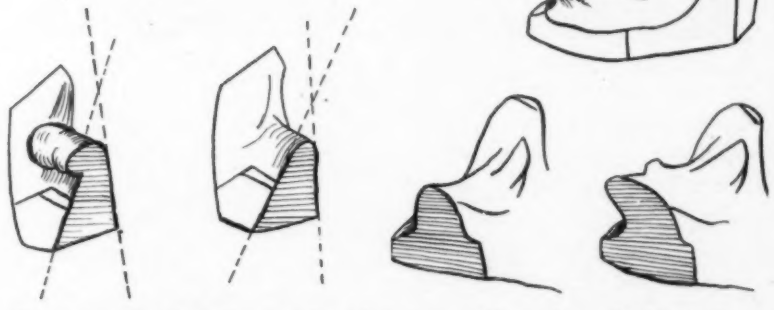

Fig. 5.—Diagram showing the overhanging bony ridge along the buccal aspect of the lower alveolar ridge. Judicious trimming of the overhanging bony ridge will make the alveolar ridge favorable for the construction of a denture.

Fig. 6.—See Fig. 5.

OPERATION TO RESTORE DEFORMED RIDGES

I. Isolated bony prominences and undercuts may be found at any part of the alveolar processes, but they are most frequently located about the tuberosity of the maxilla or in the canine regions. Among these may be included torus palatinus and mandibular exostoses.

From the diagrams, Figs. 5 and 6, it appears that if the overhanging bony ridge is removed the outline of the ridge will afford less difficulty for the construction of a denture. Briefly, the operative procedure in such cases consists of (1) making an incision either over the crest of the alveolar ridge or along the most prominent part; (2) exposing the bony prominence and trimming the process to the desired size; and (3) suturing the incision wound.

II. Massive prominences of alveolar processes are treated by the following operative procedure, the selection of which will be simplified if we differentiate definite types previous to the operation. The first type is exemplified in Fig. 7. Here we find a definite prominence of the maxillary incisors plus poorly developed alveolar bone. In the majority of cases, removal of the teeth and perhaps slight trimming of the anterior alveolar plate will be sufficient. However, in a case as shown in Fig. 7, it is obvious that removal of the teeth alone will not establish harmonious relations between the maxilla and mandible. It is necessary to trim the alveolar process of the maxillary anterior teeth, realizing that by doing so we are sacrificing the depth of the normal gingivobuccal fold. However, it is possible to remove the excess bone and at the same time extend the size of the buccal fold in the following manner:

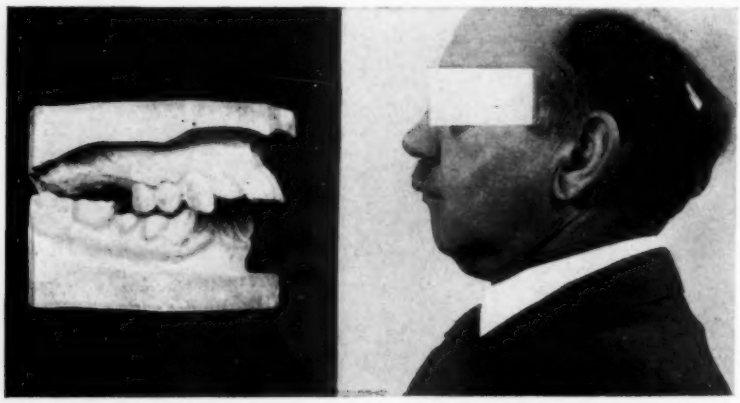

Fig. 7.—Model showing the occlusion of teeth of a patient with prominence of the maxillary anterior teeth plus poorly developed alveolar bone.

(1) Separate the labial mucoperiosteum from the alveolar plate. This may be done before or after the extraction of the teeth, according to the inclination of the operator. Expose the buccal surface of the maxillary bone well up to the nasal spine and canine fossa, as shown in Fig. 8.

(2) Remove excessive bone and suture the margins of the labial and palatal mucous membrane *loosely* with interrupted sutures as shown in Fig. 8.

(3) The next step is important and consists of placing the labial loose mucous membrane to a higher position on the already undermined anterior surface of the maxillary bone. I have found the following a simple method: place a small flexible rubber tube well up under the lip and pass interrupted mattress sutures around it. The ends of the suture are passed through the lip on to the face as shown in Fig. 10*D*. The sutures are so placed as to create an upward tension on the buccal fold. They are tied over gauze to prevent the

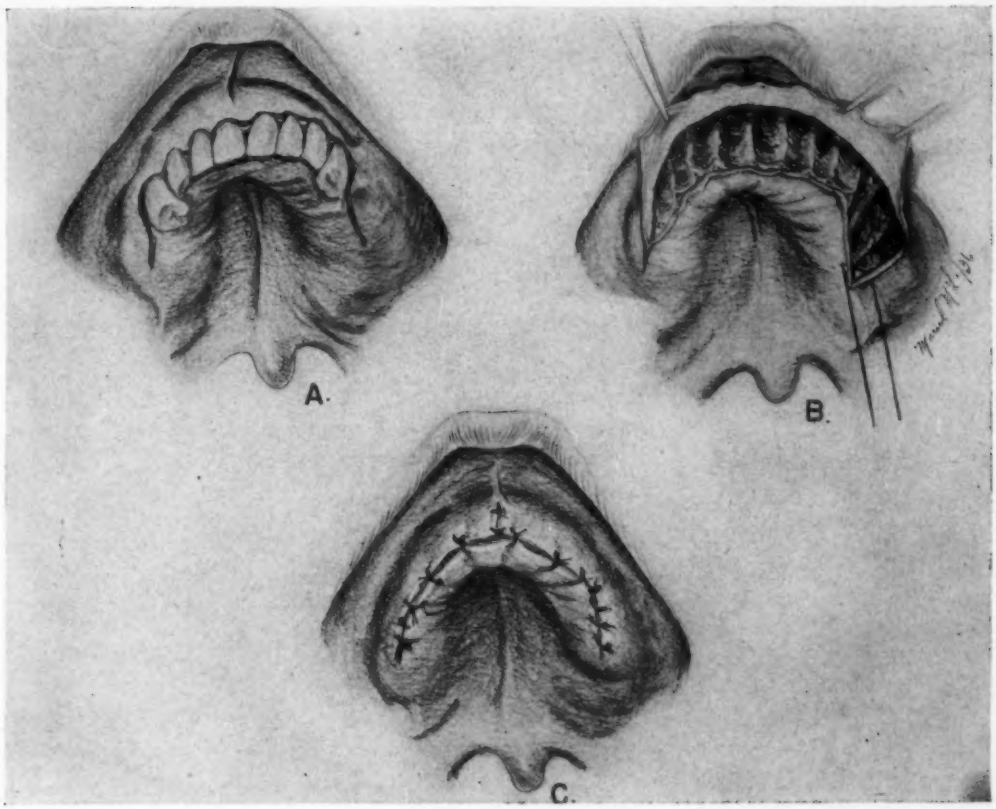

Fig. 8.—Diagram showing the various stages of operative procedure for the type of case described in Fig. 7.

A, Incision—loosening the buccal mucous membrane.

B, Buccal mucoperiosteum reflected as high as possible and the necessary amount of alveolar bone trimmed.

C, Mucous membrane incision is loosely sutured together, followed by the use of a soft rubber tube with through and through mattress sutures to place the loose labial mucous membrane in a high position.

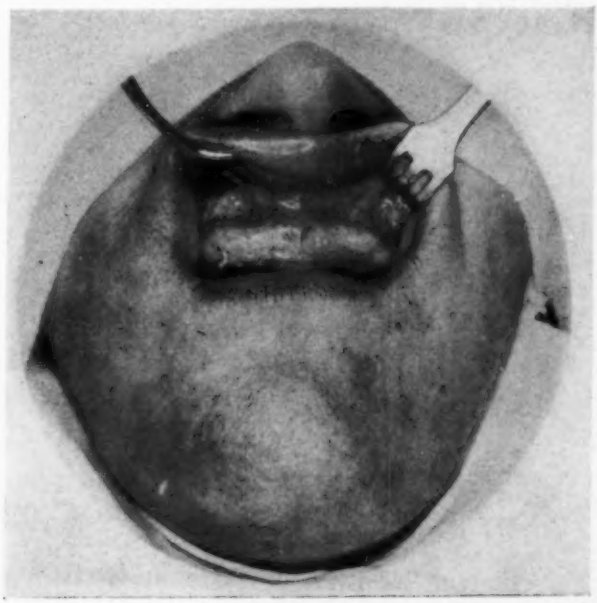

Fig. 9.—Photograph showing overprominence of maxillary alveolar ridges.

cutting of the skin. The sutures and the rubber tube should be removed within five days.

III. For edentulous mouths with overprominent alveolar ridges a similar operative procedure with but slight modifications is recommended (Fig. 9). Usually, however, mere trimming of the prominent ridge is sufficient, but if such a procedure causes dangerous diminution of the buccal sulcus, it is advisable to perform an operation similar to the one outlined above. In such cases an incision is made along the crest of the alveolar process. The buccal mucoperiosteum is separated quite freely over the anterior surface of the maxilla while at the palatal surface the mucous membrane is separated just enough to allow the removal of sufficient amount of bone, as shown in Figs. 10 and 11. Abnormalities in the mandibular alveolar processes of this type are also treated in a similar manner.

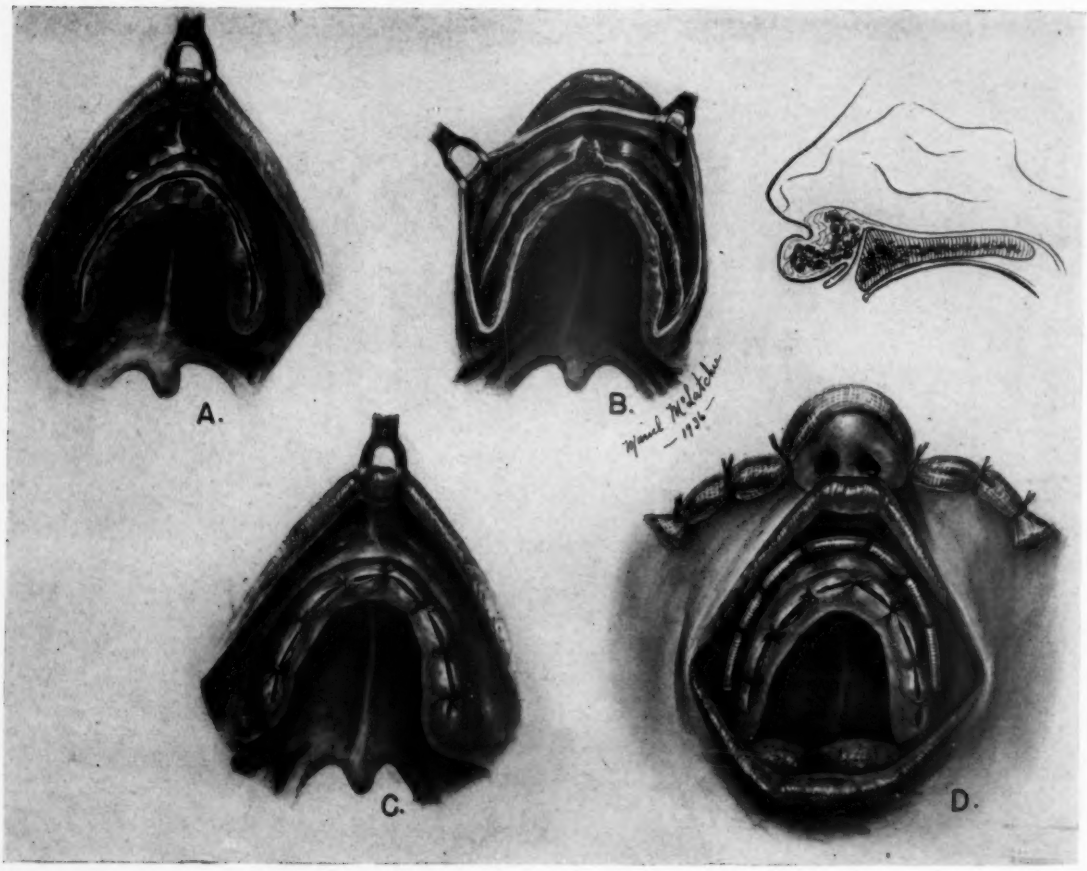

Fig. 10.—Diagram showing the incision, suturing and rubber tube in position as described in Fig. 8*C*.

IV. The fourth type of operation is shown in Fig. 12. It is indicated if the patient presents extensive resorption of the anterior alveolar ridge, in an edentulous maxilla. Here we may find flabby, fibrous tissue deprived of its bony framework. This soft tissue is often greatly hypertrophied and occurs in the form of single or multiple fibrous ridges. At times, these present difficult prosthetic as well as surgical problems. A simple excision of the loose hypertrophied tissue

may destroy the normal contour of the alveolar ridge, but an operation such as that described in the following paragraph has been found quite effective to produce conditions satisfactory for the construction of a denture. It is as follows:

1. A horizontal incision, high in the buccal fold, is made, extending almost the entire length of the tissues in question as shown in Fig. 13*A* and *B*.

2. The mucosa with subcutaneous tissue is dissected from the underlying fibrous mass as far as the very edge of the alveolar bone; a broad flap thus results as shown in Fig. 13*C*.

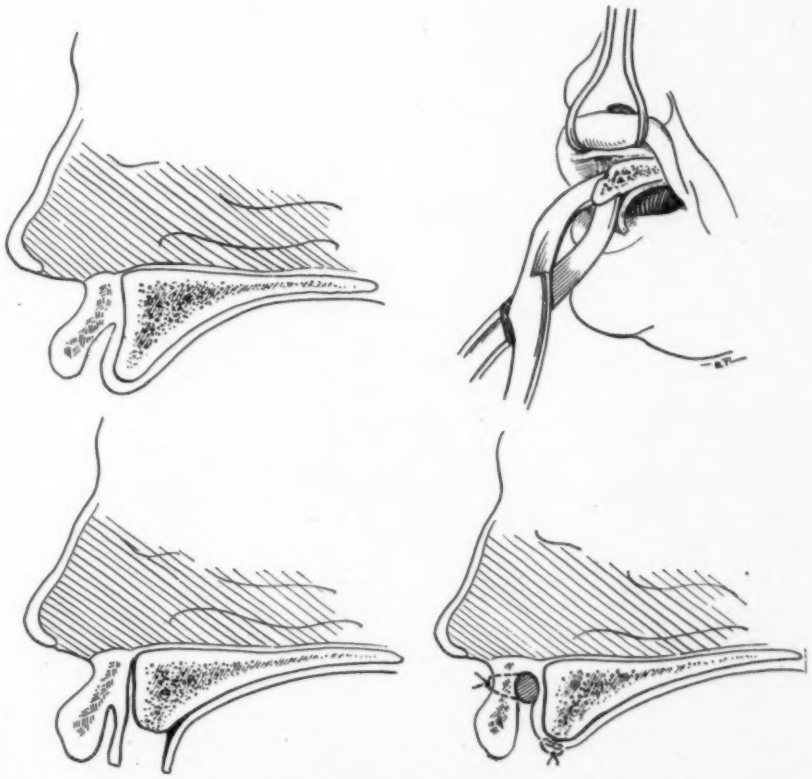

Fig. 11.—Diagram showing the various stages in the trimming of prominent alveolar ridges.

Fig. 12.—Model showing an edentulous maxilla with extensive absorption of the anterior alveolar ridge, replaced with flabby fibrous tissue.

3. All the excessive fibrous tissue from under the flap is removed, down to the periosteum, care being taken not to strip the periosteum from the bone.

4. The borders of the mucous membrane flap are sutured high up over the anterior surface of the alveolar plate into the new position, as shown in Fig. 14*A*.

5. The border of the incision on the inside of the upper lip is likewise brought into a higher position, and maintained there by suturing to the periosteum or by making through and through sutures to the skin on the outside of the face. This is shown in Fig. 14*B*.

6. Better control of the new position of the re-formed ridge can be acquired by the use of a small flexible rubber tube placed along the inner surface of the upper lip, as described in the previous operation and illustrated in Fig. 13*D*.

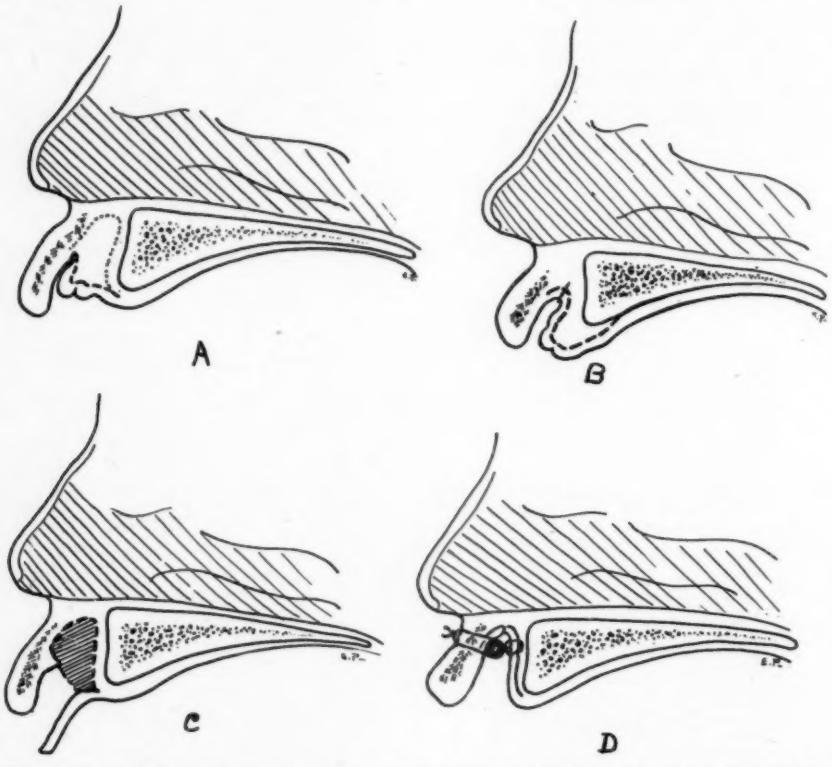

Fig. 13.—Diagrams showing the various steps and proper method of trimming the flabby alveolar ridge and in the meantime raising the height of the buccal alveolar ridge.

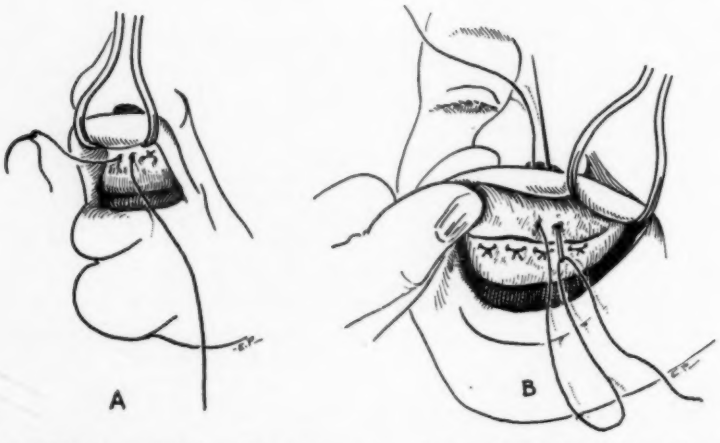

Fig. 14.—*A*, Diagram showing the mucous membrane flap attached to the alveolar ridge and extending over the exposed periosteum, then sutured in place.

B, The proximal edges of incision wound inside the lip are raised toward the newly formed groove and held in position by mattress sutures passed from the inside of the mouth to the outside.

V. Operative treatment for multiple fibrous ridges does not differ materially from the one described for type IV, except that the operator should make judicious use of the existing mucous membrane by carefully dissecting and removing the fibrous tissue under the submucosa, because under certain conditions it is necessary to excise part of that tissue to give a better contour to the alveolar ridge.

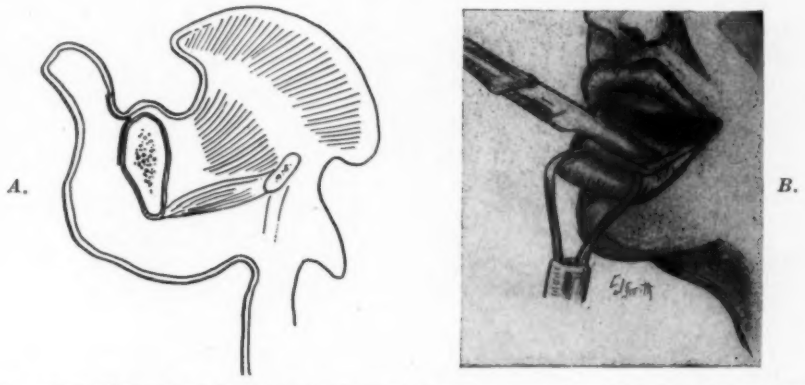

Fig. 15.—*A* and *B*, Diagrams showing horizontal incision made on the buccal surface of the lip or cheek on a line parallel to the alveolar ridge and about 1.5 cm. externally from it.

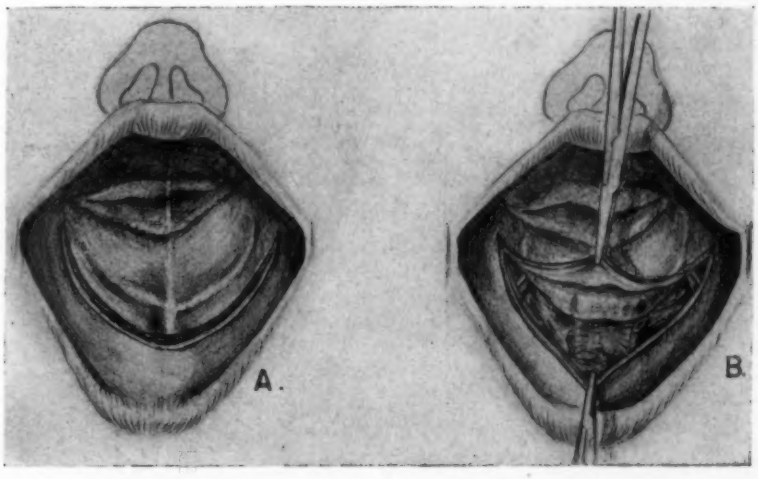

Fig. 16.—Diagrams of incision showing the mucous membrane nearest to the alveolar ridge gradually dissected toward the center of the ridge.

RIDGE EXTENSION OF LOWER ALVEOLAR BUCCAL SULCUS

Over a period of years, the lower alveolar bone undergoes many changes in the edentulous mouth. The mere weight of the artificial denture combined with the stress of mastication often causes considerable absorption of bone. In addition the attachments of various muscles attached to the mandible come nearer the crest of the ridge, leaving but very little stable base. The stability of a lower denture, even in so-called normal cases, is often difficult, but when the bony ridge is absorbed it further complicates prosthetic procedures. Fortunately it is possible to operate on such cases to extend the buccal and, to some

extent, the lingual boundaries further, thus making more room for the denture to rest upon. The operation is performed as follows:

1. A horizontal incision is made on the buccal surface of the lip or cheek on a line parallel to the alveolar ridge and about 1.5 cm. externally from it, as shown in Fig. 15.

2. With the scalpel the mucous membrane nearest to the alveolar ridge is gradually dissected toward the center of the ridge (Fig. 16).

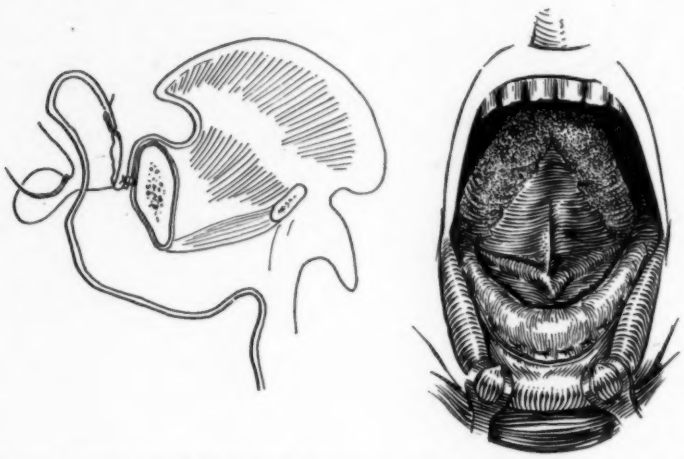

Fig. 17.—After removal of redundant tissue over the buccal surface of the mandible the mucous membrane flap attached to the alveolar ridge is extended over the exposed periosteum and sutured in place.

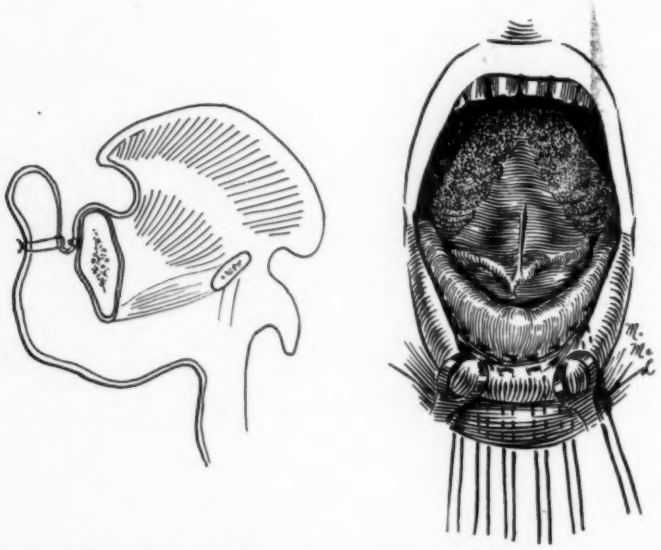

Fig. 18.—The proximal edges of the incision wound inside the lip or cheek are brought down to the newly formed groove, and held in that position by mattress sutures passed through from the inside of the mouth to the outside, as described in text.

3. All the redundant tissue as well as muscle fibers overlying the buccal surface of the mandible are dissected out as far as is needed, care being taken not to disturb the periosteum.

4. The mucous membrane flap attached to the alveolar ridge is then extended over the exposed periosteum and sutured in place (Fig. 17).

5. The proximal edges of the incision wound inside the lip or cheek are brought down to the newly formed groove, and held in that position by mattress sutures passed through from the inside of the mouth to the outside, as described in the previous operations as shown in Fig. 18.

GENERAL REMARKS

The operations which have been described are most conveniently carried out under local anesthesia, and the patient is hospitalized not more than three or four days. Usually there is slight edema and swelling the day following the operation, but the tissue reaction is surprisingly mild in comparison with the extent of the operation. The sutures passed through the skin should be removed after the third or fourth day. There are never any noticeable marks from the use of these external sutures. Within the mouth sutures of black silk can be left in place for a week.

TRANSPLANTATION OF SKIN

The indications for transplantation of skin within the oral cavity are many. First of all the operation is useful in cases where through disease or trauma a considerable amount of mucous membrane has been lost, and replaced by scars and adhesions of various extent. In cases of comminuted fractures of the jaws with extensive laceration of alveolar mucous membrane, skin grafting becomes a necessity. It may be necessary following the effects of operative treatment or radiation for malignant disease within the mouth.

Skin grafting assumes also a very important role in operative procedure in harelip and cleft palate patients, where there is definite underdevelopment and retrusion of the maxilla with corresponding flatness of the upper lip. Adequate prosthetic restoration, combined with surgery on the lip and nose, is the only means we have to restore the proper contour to the upper lip and obtain a good facial outline. However, in order to make use of a prosthetic appliance with the teeth set in normal occlusion it is necessary to make adequate room within the oral cavity, to receive such an appliance. Here we resort to skin grafting under the upper lip and along the canine fossa, by undermining the tissues freely and covering the raw area with skin graft. Transplantation of skin within the mouth is as practical as in any other part of the body. However, the following measures should be faithfully carried out to insure successful grafting:

1. The recipient area for the graft should have a good blood supply and be free from active infection.

2. The raw area must be free from bleeding before the transplant is put in position.

3. The transplant should cover all the raw area and be immobilized under moderate pressure.

The main difficulty with skin grafting within the mouth is to devise a method to hold the transplant in position. When teeth are present a splint may be made to act as a carrier. However, such an appliance must be firmly attached to the teeth and should not be subject to easy displacement. Trans-

planting skin to the edentulous mouth is more difficult. Fortunately, however, methods are available for this purpose also. A temporary denture can be made, similar to the Kingsley splint (for fractured jaws) to hold the graft in position. At other times it is possible to use the method first advocated by Esser. This consists of first excising all the scar tissue. A dental composition mold is then made to fit inside the newly formed groove. The skin graft is wrapped around this mold with the raw side out and pressed against the freshened tissue. This so-called inlay mold is held in position by the use of sutures applied through the soft tissues.

CONSTRUCTION AND ADAPTATION OF FULL DENTURES IMMEDIATELY FOLLOWING EXTRACTION OF TEETH

This procedure consists of construction of the full denture prior to the removal of the teeth and insertion of it into the mouth immediately or soon after the operation. I have noticed that this procedure is being utilized by prosthetic dentists in increasing number. This is a radical departure from the method prevailing for many years where the patient was deprived of the use of an artificial denture for weeks and months or until the tissues of the mouth had healed.

My impression of this new procedure has been quite favorable. The obvious advantages are (1) the good psychologic effect on the patient when he is assured that he will be supplied with a new set of teeth immediately, or in the shortest possible time after he is deprived of his own teeth. (2) The patient is able to resume his daily duties at an early date. (3) The presence of a denture will preserve the normal facial outline and prevent diminution of the muscular tone of the orbicularis oris. (4) The mere fact that a certain amount of normal physiologic stress is applied to the alveolar ridge tends to cause the tissues of the alveolar process to heal without much bony resorption. The mouths I have examined have shown a remarkable well-behaved healing process with very little tissue reaction and discomfort to the patient. However, like all dental operations it should not be used indiscriminately. The cases should be selected carefully, and only the favorable ones for such a procedure.

CONCLUSIONS

In conclusion the main object of this paper is to outline the correction by surgical operations of unfavorable mouth conditions which handicap the construction of efficient and esthetic dentures.

Overprominent alveolar bone in isolated areas is simply exposed and trimmed. In soft tissue abnormalities caused by excessive resorption of the alveolar bone, the operative procedures advocated in this paper are especially aimed (1) at eliminating the flabby tissue, and (2) at extension of the buccal sulcus so as to give an effective resting area for the denture.

Indications exist for transplantation of skin along the buccal groove whenever there is definite loss of the mucous membrane. Finally, more complicated and rare cases are brought to your attention. The surgical treatment of these, while more complicated, follows the same general principles as in the less extensive cases.

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PARESTHESIA*: A POSTOPERATIVE COMPLICATION FOLLOWING REMOVAL OF THE MANDIBULAR THIRD MOLAR

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THE mandibular canal containing the inferior alveolar nerve often runs dangerously near the apices of the mandibular molar teeth. During surgical operations, such as removal of an impacted mandibular third molar, paresthesia is not an uncommon occurrence. Roots may fracture during removal of the tooth, pushed into the mandibular canal, or there may be injury to the canal or its contents by instrumentation of movement of roots during the operation. Paresthesia, or prolonged anesthesia of the lower lip and chin, often occurs following blocking of the inferior alveolar and lingual nerves by local anesthesia.

Most authorities agree that extensive pathologic and infected areas along the path of the nerve supply can be responsible for certain cases of paresthesia as well as injury to the nerve by heroic curettement in removing pathologic conditions—this depending on the amount of nerve fibers destroyed. After a nerve is traumatized, regeneration is frequently retarded and is sometimes slower than complete surgical severance leaving a general paralysis to the part affected.

Pertinent to this condition, I would like to quote an experience of John B. Erich, M.D., D.D.S., with the section of oral and plastic surgery, Mayo Clinic. Dr. Erich reports a condition of "open-bite" in which he sawed through the mandible on both sides in order to correct the open-bite deformity. The mandibular nerve was severed on each side during the operation and subsequently, the patient had complete numbness of the lower lip and mandible anteriorly. However, in six to nine months, regeneration of the nerve apparently occurred, as the numbness almost completely disappeared. He further states: "In our experience very few cases of traumatic injury of the mandibular nerve produce a permanent paresthesia. These symptoms usually last about six to nine months during which time the nerve fibers regenerate."

I wish to present four cases of paresthesia as a postoperative complication, following removal of the mandibular third molars, with their subsequent recovery. These cases are adduced from three hundred patients extending over a five-year period of successful operations.

CASE 1.—E. W., a male, medical student, aged 25 years, complained of extreme pain in the mandible and occasional reflected pains in the maxilla together with an "aching feeling" in the mandibular right second molar.

Roentgenographic examination revealed the presence of an impacted third molar lying horizontally with the crown in linguoversion. The mandibular canal was shown in close proximity with the apices of the tooth; however, after scru-

*Definition of paresthesia: "Morbid or depraved sensation, an abnormal sensation, as burning, prickling, formication, etc."—*Dorland Medical Dictionary.*

"An abnormal spontaneous sensation, such as burning, pricking, numbness, etc."—*Stedman's Medical Dictionary.*

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tinizing the x-ray films, there was little evidence of pressure on the inferior alveolar nerve (Fig. 1). Extraction was advised, and nembutal, gr. 1½, was administered as a premedication one hour before surgery.

A mandibular block was performed with a 2 per cent solution of novocain and cobefrin 1:10,000 after alkalinization. Profound anesthesia was obtained in three to five minutes. A curved incision was made from the distobuccal crest of the gum of the second molar to the area of the retromolar triangle and ascending ramus. With blunt dissection the mucoperiosteum was retracted and the cortical plate exposed. With chisel and mallet the overlying bone tissue was removed until the horizontal molar was denuded in almost its entirety. A definite loose movement of the tooth was ascertained by using a No. 20 Black's spoon. With a Cryer No. 27 elevator the tooth was gently lifted from its socket with no apparent resistance being offered such as would cause traumatization to the nerve trunk (Fig. 2). A blood clot was gently stimulated and the flap closed with one catgut suture. The patient was dismissed with instructions regarding postoperative care, consisting of applying ice packs for four-hour intervals with twenty-minute interruptions of moist heat for vasodilation (Fig. 3).

Figs. 1 and 2.

Fig. 3.

The patient was seen on the following day with no edema present; however he complained of an area about the corner of the mouth and lower lip, one inch and a half by three-quarters inch in size, feeling numb. For three consecutive days postoperative irrigations of the socket were performed with the paresthesia persisting. The patient was seen the following week, and the wound was observed to be healing uneventfully. Numbness in the lip was still apparent. As soon as the soreness had subsided, hot witch hazel packs were applied followed by hand massage. At the end of the second week the typical prickling or "needles

and pins feeling'' was noticed. The patient was instructed in the use of a Cameron electromatonette vibrator to be applied twice daily. He was admonished to vibrate well over on to the lower border of the mandible in the area of the submaxillary gland and apply the soft rubber attachment for massaging the gum tissue buccally and lingually. The following week the patient returned for further observation and checkup, and it was noted by digital examination and ''explorer pricks'' the area had diminished in size to approximately an inch in circumference with the prickling and warm feeling becoming more pronounced. At the end of the fourth month, with intermittent checkups, the paresthesia had practically disappeared, together with the tingling sensation in the chin (Fig. 4).

Case 2.—R. R., a teacher, aged 37 years, complained of soreness and pain in the gum tissue of the lower left mandible. Roentgenographic examination revealed a mesiovertical impaction with buccal inclination (Fig. 5).

The tooth presented anatomically a long fused root extending close to the mandibular canal; however evidence of pressure to the inferior alveolar nerve was not apparent as the stereoscopic and occlusal roentgenographic views showed the apex lying to the buccal of the mandibular canal.

Preoperative medication consisted of nembutal, gr. 1½, one hour before surgery. A nerve block, identical to Case 1, was administered, and profound anesthesia procured. An incision was made and the mucoperiosteal flap retracted. Owing to the mesial inclination of the crown, the distolingual cusp was visible two millimeters above the gum. Dense bone tissue surrounded the tooth, and the usual chisel and mallet technique was employed to remove the buccal plate. The tooth was extracted without unusual difficulty, and upon aspirating the socket an unobstructed view was obtained showing the walls of the alveolus solidified on all sides to the base. This ruled out any possibility of a close proximity of the inferior alveolar nerve with the root.

The usual postoperative instructions were given, and the patient was dismissed. The patient was seen the following day with only a slight edema; however the typical paresthesia was present in the lip. Hot moist witch hazel packs were advised with hand massage. Notwithstanding, the numbness persisted for a period of seven months.

Periodic x-rays were obtained of the socket which healed uneventfully with no apparent changes taking place in the mandibular canal or nerve tissues (Fig. 6).

Case 3.—H. A. S., an executive, aged 49 years, complained of pressure on the mandibular right second molar, also, intermittent toothache was present during meals.

The roentgenographic examination revealed the mandibular right third molar lying in a horizontal impaction. The crown approximated the adjacent second molar causing a large distal decay which undoubtedly was the etiology of the toothache (Fig. 7). The mandibular right first molar was ascertained to be devitalized, having been submitted to electric pulp tests. The x-ray showed an infected area at the apices of the mesial root. Extraction was advised.

Hospitalization was recommended and a physical checkup obtained prior to admittance to surgery. Blood pressure was 106/74, chest examination nega-

tive, heart action normal, urinalysis negative. Premedication of morphine sulphate, gr. 1/6, and atropine sulphate, gr. 1/150, was administered one hour before surgery.

A general anesthetic was selected with anhydrous nitrous oxide and oxygen induction. Nasal tubes were inserted and ether anesthesia administered.

The usual incision was made and the mucoperiosteal flap retracted. Using chisel and mallet, the buccal cortical plate was removed. With a long bevel "sharp chisel" and mallet the crown was split off at the neck of the tooth and with a "Winter's No. 14R." cross-bar exolever the remaining roots were moved forward into the space and lifted out. The gum tissue on the buccal side of the first molar was incised and retracted. With chisel and mallet, the mesial and distal roots were exposed and removed surgically. The flaps were sutured to place with catgut ligatures No. 00 (Fig. 8).

Fig. 4.

Figs. 5 and 6.

Postoperative treatment consisted of "immediately applying" an ice pack for four hours with twenty-minute interruptions of moist heat for vasodilation. Codeine sulphate, gr. 1/2, was administered for pain.

The patient made an uneventful recovery with very little edema present. After forty-eight hours, a physical checkup was made by the resident physician and the patient dismissed.

The second day in the hospital, following usual routine irrigations, numbness was observed in the lower lip. On the third day the patient was seen in my office for the usual treatment and irrigations. The "rubber and pin" (Dr. L. T. Austin's method) was applied to the lip. An area the size of a quarter was perceived to still be numb. The mechanical vibrator was advised with as much pressure exerted as the tissue would comfortably tolerate. Daily checkups followed with the paresthesia subsiding gradually, until there was no evidence of it at the end of a six-week period. The healing of the sockets was uneventful (Fig. 9).

CASE 4.—R. S., a housewife, aged 28 years, presented a history of chronic reflected pain in the lower left mandible. She complained further of an arthritic disturbance in her left shoulder and elbow. Her physician advised a "full-mouth x-ray" which revealed a mesiovertical impaction that was undoubtedly applying pressure to the second molar. Collaboration between physician and dental surgeon concluded that extraction was definitely indicated in this case (Fig. 10).

Hospitalization was decided as the best method of approach and a general anesthetic selected. Prior to entering the hospital, her physician made a complete physical diagnosis finding the blood pressure 124/70, heart action normal, urinalysis negative, pulse rate 72, lungs negative, and blood clotting time five minutes.

Fig. 7.

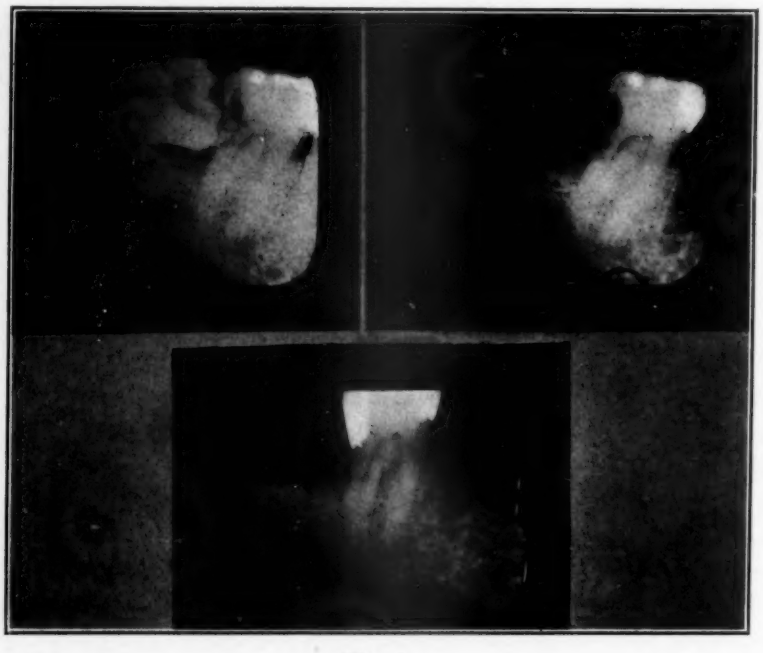


Fig. 8.

Fig. 9.

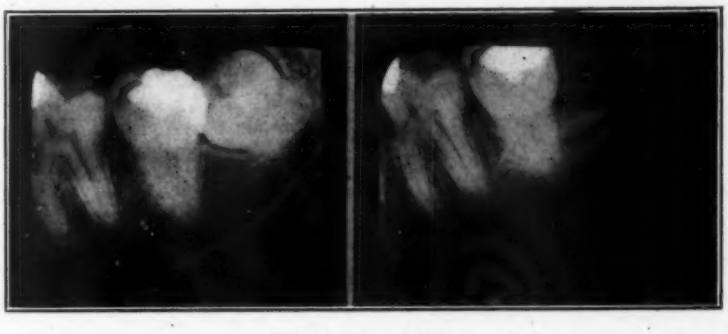
Premedication of morphine sulphate, gr. $\frac{1}{6}$, and atropine sulphate, gr. $\frac{1}{150}$, was administered one hour before surgery. The patient was anesthetized by nitrous oxide and oxygen induction with ether. The usual surgical technique was employed, consisting of incising the overlying gum tissues and retracting the mucoperiosteum. A clear field was now visible. By resorting to "chisel and mallet" the buccal plate was removed exposing the crown. A sharp blow on the long beveled chisel was exerted by an agile assistant, thus severing the tooth at the neck. More bone tissue was removed distally allowing the fused roots to be elevated to the surface. Resorting to the use of small sponges, together with the aspirator, a clear unobstructed view of the socket was obtained. The walls and apical area were intact throughout. Presumption of the analysis, in conjunction with gentle and careful exploring, revealed the interior walls completely solidified. This eliminated the possibility of an opening into the mandibular canal, which appeared quite likely, from study of the original

roentgenogram. Renewed confidence of a successful operation seemed to be definitely assured.

The usual postoperative care was applied with beneficial results. Orders were given for the patient to remain in bed forty-eight hours. The resident physician was called for a physical checkup that proved satisfactory, resulting in the patient's dismissal from the hospital.

She was admonished to return to the office the third day for treatment. At that time, she complained of a small area about the corner of the mouth and lip feeling numb. Examination again revealed a typical case of paresthesia following extraction of the mandibular third molar. Owing to the precautions and dexterity adhered to, both before and during the operation, I was naturally concerned, and at a loss, to account for this unexpected development. The existing condition was explained to the patient's satisfaction, who in turn was advised to apply hot packs, followed by mechanical vibration. She was somewhat reluctant to cooperate at first, since pain resulted when pressure was applied posteriorly. With experience and proper guidance this timidity was soon overcome.

The patient was examined twice weekly with the paresthesia disappearing at the end of a three-week period. Recent roentgenographic checkups reveal deposition of new bone tissue in the socket with no further complications appearing (Fig. 11).



Figs. 10 and 11.

SUMMARY

In searching the literature on the subject of paresthesia, I have observed that very little has been mentioned regarding its etiology, prognosis, and subsequent recovery.

Dr. Sterling V. Mead in his book, *Anesthesia in Dental Surgery,* offers a form of treatment by the use of faradic and sinusoidal current.

Most authorities acquiesce to the fact that this "most annoying" sequel of mandibular third molar surgery is much more frequent than the majority of operators care to admit; whereas, they suggest thought, study, and discussion of this troublesome condition.

Perhaps this will help stimulate and bring forth the answer; why is it that an operator, using a careful standardized technique, will experience a paresthesia in one case, yet, on the other hand, the same surgeon, employing the same care and technical procedure, fails to contact this paradoxical symptom in operating a similar case?

There is, in my opinion, a certain basic fundamental knowledge relative to the beneficial therapy of massage and manipulation to immediate and adjacent parts of the body. This being the case, why should not mechanical vibration and manipulation prove beneficial to the regeneration of injured or traumatized tissue? Observing an ancient rule, pain is referred to an area of higher sensibility, that is, nervous reflexes may cause a neuritis due to sensory impulses being transferred to nerves of higher sensibility. The afferent impulses go to the spine and out over motor nerves, thus causing contraction. By manipulative treatment the circulation is stirred up, stimulating regeneration to the injured nerve cells, by the removal of possible congestion around the nerve trunk. Exercise of the cervical spine would no doubt hasten the return of sensation to the area affected.

It is my contention that any manipulative treatment of the motor and sensory nerves, whether local or cervical, should receive pertinent consideration. Perhaps this is a thought for further discussion and research by my contemporaries. I would not presume, however, to offer the above-mentioned suggestion as a panacea for every existing case of paresthesia.

CONCLUSIONS

1. The patient should be advised as to the possibility of a paresthesia occurring following surgery, thus eliminating annoying postoperative apprehension and concern. A reassured patient is the most cooperative.

2. A standardized surgical technique, in regional surgery, should be employed with necessary precautions to minimize trauma.

3. Careful roentgenographic examination (preferably with your own unit) stimulates close observations and study, thus assuring a proper preoperative diagnosis.

4. Caution should be exercised in the removal of impacted mandibular third molars, especially those with a history of subtleties of color, chronic inflammatory tissue, and pericoronal infections.

5. Alleviation of pressure and congestion around the nerve trunk, by manipulation of the cervical spine, directly stimulates circulation of the local area affected.

6. Care, relative to surgical procedure in adult cases, should be exercised. The foregoing presumptive analysis indicates that fully formed roots present a greater hazard during extraction than the undeveloped third molars of young people.

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505 American Trust Bldg.

THE INFLUENCE OF GEORGE B. WINTER ON THE DEVELOPMENT OF EXODONTIA

FRANK W. ROUNDS, A.B., D.D.S., BOSTON, MASS.

NEARLY every text dealing with the historical background of dentistry starts with a caption such as, "The extraction of teeth undoubtedly is the oldest branch of surgery." We have learned that the statement is well founded; that dental caries is the oldest and most prevalent disease to which man is heir; that its ravages have been universal in all ages; that ancient philosophers and soothsayers, medieval medicine men and charlatans as well as modern empiricists have endeavored in diverse ways to combat the devastation wrought by the aching tooth. As we scanned the scripts, we have found that their activities culminated in the same result. They applied medicaments to render the surrounding parts gangrenous; they offered incantations to their gods; they employed various mechanical devices and were unaided by pain-relieving adjuncts except soporific drugs, yet dental torment throughout the ages has been a constant source of travail and the removal of the offending member a "consummation devoutly to be wished."

It is interesting to note that aside from the contributions of Fauchard, scarcely any progress toward the solution of the problem was made from the dawn of history until the middle of the last century. The first real technical advance was contributed by Tomes, an English dentist, who devised the "anatomical forceps"; the key had been the instrument of choice up to this time. These forceps, each with a working point adaptable to the tooth in question, made tooth pulling, "So simple by comparison with earlier methods that an Augustan age of extraction was ushered in."

Our immediate predecessors were pseudo-operators, such as peddlers, blacksmiths, and barbers; the physician also participated as necessity arose. So time passed, and the beneficent aid of gaseous anesthetics came into the picture. Nitrous oxide, ether, and chloroform brought surcease from the torture of the unfortunate victims. In 1884 cocaine was introduced. Often marketed under various trade names and its employment accompanied by frequent disasters ranging from syncope to death, it became the forerunner of our present highly developed local anesthetic procedure.

These pain-relieving agents necessarily brought about more refinements in the technique of tooth extraction, and the period produced operators of exceptional manual dexterity. With anesthesia in its infancy and with only limited experience in its administration many dentists became extremely adept with forceps. Coincidentally and logically a literature began to develop, for it has always been significant that technical improvement has found its way into print and has thereby been perpetuated. Dentists have never been niggardly in hoarding their knowledge.

Thus we arrive at the turn of the century. The last fifty years had brought out the only real advances made in our science and art since the history of man began to unfold itself. It is to be noted, however, that this progress was mainly empirical in character and scarcely any scientific research connected with tooth extraction had ever been attempted.

A few years more drifted by and we reached the decades with which many of us are familiar. Dentists were performing extractions in the same general way their predecessors had performed them. Cocaine was driven under pressure into gums which blanched under the impact. Although the value of oxygen in combination with nitrous oxide had long been recognized as a useful adjunct in prolonging anesthesia, from a practical point of view the old method of saturation was in vogue. Oxygen deprivation to the point of asphyxia was the common technique and recognized as good and proper. With the patient blue from cyanosis, eyeballs staring, tongue swollen, legs and arms sprawled to all points of the compass, backs arched to opisthotonos, the resistant victim was then considered ready for operation and the extractionist did his best—sometimes his worst. Under the conditions his worst was ofttimes good. The specialists throughout the country could be counted on the fingers. Their specialty was usually designated by clumsy and ambiguous terms, such as, "Extraction Specialist," "I Extract Teeth Only," "I'm a Specialist," "I Limit My Practice to the Extraction of Teeth." "I Do Extraction Only." Many of these men were our revered pioneers—all honor to them They blazed the way for the scientific investigations of today. By individual aptitude, by interchange of ideas, and by the hard road of trial and failure they achieved local fame and proved that above the mean of ordinary performance there is always the better way which may be attained only by individualistic and painstaking experimentation. Necessarily, however, their results were limited because there was lacking a background of scientific training in research or a reliable literature. They reached their objective in eliminating the aching tooth. Beyond their horizon were knowledge in pathology and the safeguards of sterility. The disastrous results of trauma were common sequelae.

The previous paragraphs have briefly summarized the march of time. "The oldest dental operation" was born in antiquity. Its adolescence consumed centuries. Only twenty-five years ago did it approach maturity. But this quarter of a century has brought about more progress in this branch of practice than all the preceding years put together.

The development of any art or science as in discovery and invention invites a corresponding growth of language. Words which will convey a proper conception of whatever has been unfolded and brought to light must be supplied or much that is gained is subsequently lost. Dentistry has from time to time made a similar demand. For many years now there have been dentists who limited their practice to the extraction of teeth. That this specialty has progressed until it also requires adequate descriptive terms few will question and none can deny.

Twenty-five years ago an unknown author completed a textbook on the extraction of teeth. Since that time, the name of George B. Winter has be-

come an international synonym for those things that pertain to our present concept of the principles and practice of tooth extraction.

Only his oldest and closest friends are aware of the intimate circumstances which influenced the development of his career and molded his professional progress. Geographical frontiers have long ago been conquered. The frontiers of science are ever before us, ever expanding, and ever reaching out ahead to new unexplored vistas. Let us summarize briefly the accomplishments of this pioneer in dental science. To us who know him well his career is a source of pride, to the youthful aspirant to professional fame it should serve as a stimulus.

George Ben Wade Winter was born in Brooklyn in 1878. His father, a newspaper man, whose work took him to various cities, finally settled in St. Louis. Eventually he left the financially precarious field of newspaper work, entered business and achieved moderate success until the panic of 1897 engulfed him. At the age of sixteen George was dependent upon his own resources for further education and livelihood. By his own endeavors he worked his way through elementary and high schools and carried on to obtain his professional education.

Then came a few years of general dental practice. He gives great credit to the influence of such leaders as Edward Angle and A. Bromley Allen in shaping his destiny. Endowed with a restless spirit which impels one to go on from one accomplishment to another he never was satisfied with a merely creditable showing. He decided to specialize in the field that he liked best and for which he had shown the greatest aptitude. In this phase of practice he became a leader but once more his innate desire to progress became insistent. He had become convinced that methods of tooth extraction could be improved upon. His experience as a teacher in St. Louis University led him to realize that means of instruction were decidedly limited and far less efficient than one could wish. The literature in this special field was meager. The crude methods of the day made clinical demonstration unsatisfactory to the exacting scientist. Asked to conduct a course of several lectures he found the sum of published knowledge on this subject could be told in a very limited time and that the material was a hodgepodge of random information.

The next four years were spent in intensive research during which he evolved a scientific basic principle upon which tooth movement during extraction was established. In 1913 he was ready to publish his findings and so twenty-five years ago he produced his textbook on the extraction of teeth. This book was the first comprehensive work on this subject that had ever been brought to professional attention. He captioned it with a title that has not only become standard in the science of tooth extraction but which also designated the individual who specializes in the removal of teeth. The thought and study given to this manifested the same thoroughness with which he has undertaken every other task or assignment.

Before a single word was put on paper and before even one of the many illustrations was planned, he was first obliged to do the thing he was to write about; not once but thousands of times so that the technique might be perfected. He must be absolutely certain he was right. As a result of this original research the word he coined was "exodontia," and he dignified

the specialist with the name "exodontist." In short he created a new specialty. Most research is based on and is a development of an extensive literature left by earlier workers. He had no such background for he was investigating a new scientific frontier. In fact it was lack of earlier scientific investigation which led him originally to inaugurate his studies.

This text on exodontia created an enormous interest among dental men. The small edition of only five thousand copies was soon exhausted. It is now listed among rare works, and a large premium must be paid to obtain a copy today. The last chapters were devoted to the removal of impacted teeth. No sooner was it published than the author, impelled by the "divine discontent" which has always characterized his activities, became dissatisfied with this section. He was convinced that his initial effort had not solved the problem; he was sure that there must be a better way. At that time the x-ray was new, and radiographs were often inadequate. Once more he started research. Many cases of impacted teeth were being presented which clinical examination had failed to reveal. He felt the need of a definite operative procedure to eliminate the brutality and trauma which then accompanied their removal. The revelations made by improved x-ray technique which he mastered, combined with the knowledge and experience gained by his investigations, convinced him that such methods were unnecessary. For twelve years he labored. Thousands of impacted teeth were studied preoperatively, operatively, and postoperatively. The world was searched for mandibles of man from prehistoric times to the present. All findings were painstakingly tabulated and classified. As a result he had, in 1926, completed a text of eight hundred and nineteen pages devoted to the mandibular third molar when impacted. It was amplified with hundreds of illustrations which alone rendered the classifications visible to the student and exemplified the operative procedure in detail.

This edition also was soon exhausted. Doctor Winter's former students, hundreds in number, and others interested in this phase of practice quickly consumed the product. Even operators who did not wish to master the technique for their practice were thoroughly convinced that the comprehensive classification was correct. It was felt that the last word had been said and written on this subject. In the author's mind, however, there still remained further work to be done. He felt that there must be some superior method of making clear the technical procedure; a method that would go beyond the limitations of the printed word and even of the clinic. At the International Congress in Paris in 1932, he felt that he had found the medium he needed. Upon his return he immediately investigated the possibilities for producing scientific motion-pictures to illustrate his work. After long experimentation he completed his first production; a silent movie which was shown all over the United States and abroad with such success that again he was stimulated to further efforts.

It was a short but logical step from the silent to the talking picture. His new sound movie was first presented at the Second District Dental Society of Brooklyn, N. Y., in 1936. The results of all his years of research and investigation were so clearly demonstrated by this means that they were easily available to all. This method of propagating scientific investigation has attracted uni-

versal attention. Boldly and convincingly it has put before the dental profession the fascinating probability that much constructive dental teaching of the future will be based upon this new type of visual education.

During this period, of which this occasion represented the silver anniversary, many men have offered extensive research findings in this field for our mutual benefit and profit. This sketch is intended not at all to minimize their contributions. It is only presented to give just due to the genius whose insatiable thirst for investigation based on accurate scientific data as opposed to guesswork has served as a stimulus for present and future workers. He is truly "The father of modern exodontia."

Like all men who are creators, he has met in the past vigorous opposition to his ideas from many quarters. After all these years, however, the results speak for themselves.

I close this résumé of great achievement with one more significant fact as expressed by Doctor Oliver at a testimonial given Doctor Winter in Memphis: "These long years of labor, of time and energy freely expended are his personal contribution to humanity. He has never received one dollar in research grants but has carried his work through on his own responsibility. I note this fact not merely by way of offering tribute to a devoted scientist but in order to call attention to the disconcerting fact that in the past dental research has not received the same recognition or been given the same financial support as has been so bountifully supplied to medical and other interests.

"May we not hope that the day of such neglect is drawing to a close and that we are coming to a time when, through such examples of devoted service, the consciousness of the importance of dental research will be further awakened and made to count for human benefit."

270 Commonwealth Avenue

Case Reports

Dr. A. C. Hitzelberger of Utica, N. Y., reports a case this month, a case of noma, which is fortunately a rather uncommon disease. All contributions to this department should be sent to Dr. Kurt H. Thoma, 53 Bay State Road, Boston, Mass.

CASE REPORT NO. 36

NOMA OF THE CHEEK

A. C. Hitzelberger, D.D.S., Utica, N. Y.

I FIRST saw the patient at his residence late in March, 1939. He had been confined to his home for six months on account of myocarditis. The patient was a police officer. He had been a public blood donor and had given seventy-two transfusions since 1932. His weight, previous to this illness, was 285 pounds, present weight 165 pounds. Since December, 1937, the patient had been getting ¼ grain morphine every four hours.

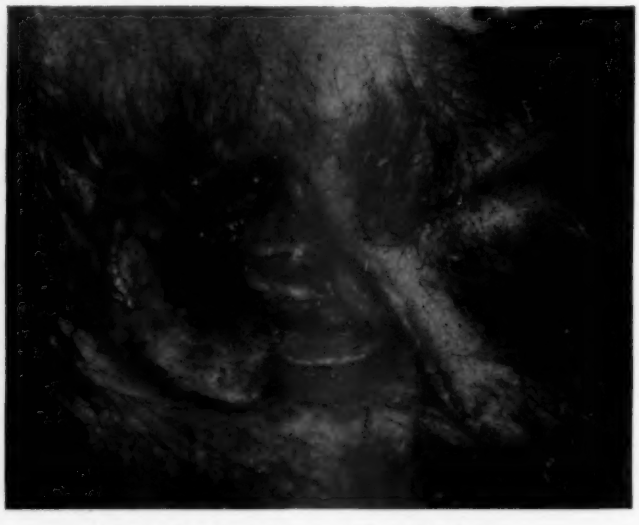

Fig. 1.—Noma of the cheek.

The patient complained that he had several loose teeth which were very sore. The physician wished them removed to make the patient more comfortable.

Examination.—Examination showed considerable swelling under the eyes. The breath was extremely foul, mucosa edematous and ulcerated, teeth extremely loose and sore, lips edematous.

Treatment.—Two or three teeth were removed from time to time as they became loose. Mouthwash of bichloride of mercury, one to two thousands in hydrogen peroxide, was prescribed. The infection was the fulminating type, and within three days the mucosa of the left maxilla was involved from cuspid to tuberosity and to the median line of the hard palate. I was suspicious of leucemia and had a blood count made, the results of which were as follows:

White Cells	16,000
Filaments	51 per cent
Nonfilaments	30 per cent
Lymphocytes	19 per cent

A smear was taken from the slough, which was negative. On culture, Gram-positive cocci in single pairs and clumps resembling staphylococci were found.

Prophylactic measures were continued and loosened teeth removed. Sulfanilamide and prontosil were given as follows:

Sulfanilamide 15 grains every 4 hours for 2 days (180 grains).

Prontosil 5 c.c. every 4 hours for 2 days (60 c.c.).

Fig. 2.—Noma of the cheek.

This was repeated after two days. The left side of jaw apparently improved, but the entire right side and the anterior region became affected.

Bismarsen 6 Gm. in 3 ampules were given, one ampule at a time.

Large sequestra were removed from the maxilla, including practically the entire buccal plate from the canine to the tuberosity. The patient seemed to improve after removal of the sequestra. However, late in April the same progressive infection affected the right side and continued to involve the cheek and later the eye (Figs. 1 and 2). The patient's condition steadily be-

came more serious. He was unable to take nourishment; the doses of opiates were increased, and frequent hemorrhages of the mouth were weakening him. In July, he had a severe cardiac attack and convulsions from which he never fully regained consciousness. There was retention of urine; his speech was affected, and there was stiffening of the neck and entire body. No nourishment was taken. Opiates gave very little relief from convulsive twitchings. His pulse became very weak and hardly perceptible. He was semi-conscious for very short intervals and expired July 19, 1939.

Department of Orthodontic Abstracts and Reviews

Edited by

Dr. J. A. Salzmann, New York City

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Critical Remarks Relating to the Growth in the Mandible During the Shedding of the Teeth and the Formation of the Chin: By Professor Dr. Paul Adloff, Königsberg, *Deutsche Zahn. Mund. und Kieferheilkunde* **6:** No. 7, 1939.

A number of anomalies of position are said to be due to the lack of space. Therefore, it is of utmost importance for the orthodontist to examine and determine, if necessary, the degree of enlargement of the dental arch in both length and width, i.e., in transverse and sagittal direction, taking place during the replacement of the deciduous teeth by the permanent set.

The permanent incisors are larger than their predecessors, and therefore require more space. This seems to demand an enlargement of the arch, if the permanent teeth are to obtain a normal position. However, Hunter has maintained that there is no enlargement of the dental arch, because the larger permanent teeth find sufficient room in the jaw; the deciduous molars being wider mesiodistally than their successors, the premolars, the space thus saved goes for the benefit of the front teeth. Since that time, this question has always been raised anew, without uniformity of opinion, because of the difficulties relating to investigations that seek to determine minute differences. Generally, individual progress of growth can be investigated and measured only in living man. Bell has recognized that this is true also with respect to the jaw, and that occurrences relating to the growth of the jaw can be recognized with certainty only by observations of the same individual at different stages of development.

This can be easily accomplished by the dentist by taking impressions of the jaws of the same person at definite intervals, and measuring and comparing the stages of development, thus fixed, on the casts. According to Adloff's opinion, of all the investigations of dental authors, those of Korkhaus[1] are particularly valuable and reliable. The result of these investigations is the discovery that a widening of the dental arch occurs during the change from the deciduous to the permanent dentition. This is on the average 3 to 4 mm. but may be also 6 to 7 mm., and perhaps still more. The variations of the height of the dental arch, however, are inconsequential in most cases, though they may be occasionally up to 4 or 5 mm. At all events, there is an increase in width and sagittal growth to a varying degree.

The complex problem of the development of the chin is discussed by Adloff only in so far as its connection with growth of the jaws is directly or indirectly

concerned. It is well known that the chin, a specific human characteristic, occurs only in the *hominides*. It is found in perfect form only in recent man, while it is missing in the anthropoids.

Walkhoff[2] was the first to investigate the development of the human chin. However, of all the results of Walkhoff's investigations, only the question of the importance of the reduction of jaws and teeth is discussed today. Bolk[3] stated (1924) that the permanent teeth in man do not require more space than the deciduous set which they replace, because of the small width of the permanent premolars. Bolk's investigations, however, are concerned with the mandible, exclusively. He even states that the permanent teeth have the tendency to be shorter in mesiodistal configuration than the deciduous teeth which they replace. Bolk does not consider the interdental developmental spaces as evidence of the widening of the jaws. He considers the spaces between the deciduous incisors to be caused by the wearing down of the crowns to the narrower mesiodistal dimensions gingivally of the deciduous incisors.

However, the jaw as a whole, in conformity with the general growth of the individual, must enlarge so greatly, that in the sixth year there is present sufficient space for the first permanent molar. This enlargement of the body of the jaw is performed in such a manner as to move forward new material from the area of growth in the back part of the jaw. In the interval between the termination of the eruption of the deciduous teeth and that of the first molar, the entire body of the jaw, including the alveolar portion, enlarges. After the eruption of the first permanent molar the enlargement of the alveolar process stops for several years. This cessation of growth, however, does not include the basal part of the jaw, which moves forward under the alveolar part and thereby forms the prominent chin.

Weidenreich considers the cause for the formation of the chin to be due to the quiescent alveolar growth interval between the eruption of the first and second permanent molars, when a continued forward growth of the basal part of the mandible takes place.

The reduction of the size of the teeth themselves, particularly of the roots, causes a shortening of the entire dental arch. The size and strength of the basal part of the jaw is dependent to a certain degree upon the teeth. Therefore a weakening of the teeth, accompanied by diminution of masticating pressure, also affects the basal part of the jaws. This is substantiated by observations on recent man, whose entire jaw has experienced a diminution in size.

One more factor of importance is the mesial migration of the teeth. This shifting in a mesial direction also exercises an influence on the length growth of the alveolar process. The formation of the chin can be sufficiently explained only by the presence of active changes. The latter are part of a gigantic transformation of the genetic development of the homonides, affecting not only the jaws and the teeth but also the entire skull.

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Some Influences in the Etiology of Malposed Third Molars: By H. T. Roper-Hall, London, Eng., *The British Dental Journal* **67**: 593, 1939.

Roper-Hall deals here with third molars malposed in their normal position, not with teeth which develop in positions remote from the normal. The fact is emphasized that the removal of a more anterior tooth to facilitate eruption of a malposed mandibular third molar must be properly controlled. This reviewer has shown the dangers of uncontrolled extraction in a number of publications.*

Anatomic factors in the causation of malposed third molars are listed as follows: (1) Lack of premaxillary development and proportionate lack of mandibular development. (2) Delayed developmental growth of the antrum resulting in arrested downward rotation of the maxillary molars with stoppage of the third molar at the posterior antral border. These cases show concomitant growth deficiency in the molar region of the mandible. There are other factors which deal with the general developmental growth of the maxilla, mandible, and adnexa.

During the erupting process of the permanent teeth, between 6 and 18 years, the mandible must increase in length approximately the width of two molar crowns; otherwise, impaction of the third molar will take place.

In the maxilla all the molars are formed and erupt immediately in front of the lateral part of the palatomaxillary suture, and laterally to the palatal bone, and anterolateral to the pterygoid processes, indicating that there are constant factors in the buccal deviation of the maxillary molars. In the mandible all the molars erupt just anteriorly and lingually to the root of the ascending ramus, indicating that: (a) The maxilla grows anteriorly from the palatomaxillary suture. (b) The mandible grows anteriorly from the root of the ascending ramus. (c) The growth of both is dependent to a large extent upon the eruption of the teeth at normal times, and full development is usually delayed until the third molars are in full occlusion.

The direction of eruption of the maxillary molars is backward and downward in such a direction that malposition is not easy, but in the mandible the direction is exactly opposite, being forward and upward; in this way it is easy for a corner of the erupting third molar to come into contact with the posterior aspect of the second molar and to be held there while the forces of eruption make the position worse. The mode of eruption of maxillary molar teeth, combined with the thin outer alveolar plate, enables the third molar to erupt buccally to the second molar, and prevents an impaction, but the massive structure of the mandibular "gutter" prevents gross deviation either to the lingual or the buccal sides.

In the maxilla there is a potential forward movement of the permanent molars, and in the mandible a backward movement of the second premolars, but no intrinsic forward movement of the molars, which fact has an important bearing upon the tendency of malposed mandibular third molars to remain in an abnormal position in spite of the previous extraction of anterior teeth. These facts have also been substantiated by the writer.†

*Salzmann, J. A.: Rate and Direction of Orthodontic Change and Effect on Incidence of Caries in Five Hundred Adolescents Following Caries, Filling or Extraction of First Permanent Molars, J. A. D. A. **26**: 1991, 1939.

†Salzmann, J. A.: A Study of Orthodontic and Facial Changes and Effects on Dentition Attending the Loss of First Molars in Five Hundred Adolescents, J. A. D. A. **25**: 892, 1938.

The amount of space available for the third molar (which, it is almost true to say, it has to provide for itself by its own eruptive force) is very circumscribed, as it is limited anteroposteriorly by the posterior aspect of the second molar and the root of the ramus, from side to side by the "gutter" formed by the mylohyoid ridge and the oblique line, and in total height by the mandibular canal below and the occlusal surface of the maxillary third molar above, and depends upon whether the "molar shelf" posteriorly is close to the ramus or more lingual.

The mandibular third molar is formed within the ramus of the mandible, and its eruption depends upon the correct development of body, ramus, and angle.

At the time when the crown is commencing to calcify (9 to 10 years), several things occur which have a profound influence upon its eruption and position: (1) Elongation of the mandible to permit the eruption of the second molar. (2) Decreasing angulation between the body and the ascending ramus of the mandible. (3) Increased depth of the eminentia articularis with restricted movements of the temporomandibular joint. (4) Ossification of the cartilage in the anterior region of the ascending ramus.

Mandibular third molars usually begin to calcify with the occlusal surfaces tilted slightly forward and as the mandible increases in length to allow room for eruption, the forming roots drift forward, correcting the anterior tilt and permitting normal eruption; if this mechanism fails, impaction or maleruption results. It is obvious that as the normal position of the calcifying crown of the mandibular third molar is slightly mesioangular, very little aberration in growth of the mandible is necessary to cause it to be impacted against the posterior aspect of the second molar.

The mandible may fail to grow in length and cause difficulty of eruption or suppression of third molars (Brash, 1924). This is one of the objections to extracting second molars in the hope of ensuring easier eruption, as in fact early extraction of an anterior tooth may cause a slight malposition to become worse.

Out of 100 side-face radiographs chosen at random, there were six cases of unerupted third molars; three were under 14 years. The others showed one mandibular third molar lingually malposed; one mandibular third molar "impacted" mesioangularly, and the other, both maxillary and mandibular third molars malposed.

Unselected radiographs of 100 adult unerupted third molar teeth showed eighty-two in the mandible and eighteen in the maxilla (all in good position). Of the mandibular cases: forty-two were mesioangular and ten horizontal in position. These findings show that the maxillary third molars are rarely, and the mandibular ones more frequently, malposed and mesioangularity accounts for the majority of the latter.

Maxillary third molars give trouble much less often than the mandibulars by disorders of eruption and gross misplacement.

The follicle of the mandibular third molar is quite soft and little calcified at 8 or 9 years so that when the temporomandibular joint is altering and the angularity of the ramus is becoming more acute, it is easily distorted and given a mesioangular inclination, and less room for eruption.

Eruption may be prevented by a supernumerary tooth (Murphy, 1936, and Smith, 1939); an abnormal amount of alveolus (Merry, 1936); and Sprawson (1937) gives "cysts of eruption" as a cause and says that 13 per cent of all dentigerous cysts involve third molars.

Doubleday (1936) reported a case of bulbous crown of a mandibular third molar tightly held in the bone and thus prevented from erupting, and also a case of delay due to a cyst underneath the tooth, and Mudie Petrie (1938) a case showing both these conditions. Other possible causes are divergent roots which prevent normal eruption (Hogan, 1936), incomplete calcification preventing the natural "urge of eruption" (Barr, 1934). "Moulding" of the face and jaws by prolonged labor and "bone currents" may have an effect in allowing the tooth follicle to drift into a wrong position (Coleman and Bennett, 1914), and Colyer (1938) thinks that sometimes $\overline{8 \mid 8}$ are given off from the tooth-band further back than is normal, hence impaction within the ramus.

The Diet of Adolescent Girls, With Special Reference to Nutritional State and Dental Caries: By Leona M. Bayer, M.D., San Francisco, *J. Pediatrics* **16**: 56, 1940.

A report has been made on data collected with regard to dietary habits, nutritional status, and dental caries, in the course of a longitudinal study on some eighty normal adolescent girls. The report is largely based on the facts coming from examination in 1932, 1934, and 1938, when the girls were respectively 11.5, 13.5, and 17.5 years old. Diets have been scored with regard to total and fractional nutritional adequacy. A separate inquiry on starches and sweets was scored for 1939.

Analysis of the diets permits the following conclusions:

1. The diets are generally poor, containing on the average only about two-thirds of recommended essentials.

2. The greatest deficiency is in vegetables, fruits, milk, and whole cereals.

3. Although no correspondence between low diet adequacy and high carbohydrate intake could be demonstrated for individuals, the total impression given by group menus was that the deficiency in nutritionally desirable foods was largely made up by starches and sweets.

Clinical investigation showed that:

1. Judged by photographs and graphs of body build, about half the group could be considered as having optimum weight. The other half were divided quite evenly between overweight and underweight. The girls with optimum weight showed a diet adequacy which was slightly superior to that of the latter groups.

2. Dental caries was evaluated for the group by making counts of decayed, missing, or filled permanent teeth (D.M.F. count) as they appeared at semi-annual medical inspection. The counts rose from an average of two diseased teeth at 11.5 years of age to an average of nine at 17.5 years of age, the range being from 0 to 21 D.M.F. teeth at the last medical examination.

No statistical relationships for the group between poor teeth and poor diet—either inadequate or high in starch and sweets—could be demonstrated. Probably no diets were good enough consistently to exert a protective influence.

However, a detailed case study was undertaken in which the factors of constitution, care, and diet were all considered. It appeared likely that favorable diet had protected one set of natively good teeth, that unfavorable diet had contributed to the breakdown of another good set of teeth, and that poor diet had played an incalculable role in the decay of three natively poor sets of teeth.

In conclusion, it may be said that, if clinical benefit is to come from the application of available nutritional knowledge, the public must be much more vividly educated to the details and values of an optimal diet.

Vitamin D Potency of Human Breast: By Robert S. Harris, Ph.D., and John W. M. Bunker, Ph.D., F.A.P.H.A. *American Journal of Public Health* **29**: 744, 1939.

The experiments reported in this article are well developed and show that there is very little or no healing of rachitic lesions in rats when fed whole breast milk or its cream fraction. Ten grams of the butter fraction produced healing but not the required corresponding gain in weight. Isolation and assay of the nonsaponifiable fraction from the butter indicated an equivalent of 4 U.S.P. XI units of vitamin D per quart. This figure is apparently quite representative since the analysis was made on fifteen gallons of breast milk gathered from wet nurses with the aid of the Boston Dispensary during December, 1937, and January, 1938.

Whence then, the greater power of breast milk, even in the winter, to protect the human infant against rickets more adequately than modified summer cow's milk, the latter containing at least 11 U.S.P. XI units per quart? Of great import is this question, especially now when vitamins are being isolated one day and synthesized the next. In the glory of laboratory conquest and immediate benefits of therapy for acute disease is ofttimes forgotten the complexity of the compensatory mechanisms which are at work to save the breakdown of any one of them. Well-directed feeding requires the administration of vitamin D in the second month. When thus supplied, the infant is better prepared to cope with insufficiency of the particular factor if the supplies of other essentials are at optimum levels of quality and quantity. A healthy nursing mother supplies her infant with nutriments especially adapted for it—specific caseinogen, lactalbumin, lactoglobulin, type of curd found in the stomach, pH, antibacterial, and other yet unknown substances. Besides, taken directly from the breast, the milk is sterile and always of proper temperature.

Frances Krasnow, Ph.D.

Frequency of Congenital Malformations in Families. Editorial, *J. A. M. A.* **114**: 141, 1940.

Little is known concerning the predisposition of families toward congenital defects. Murphy[1] in Philadelphia studied the families of those whose names appeared on death certificates with a diagnosis of congenital malformation dur-

ing the five year period 1929-1933. From analysis of the information obtained it was concluded that gross congenital malformations, as recorded on death certificates, afflict approximately one of every 213 individuals who are born alive. About a quarter of those born congenitally malformed are stillbirths. The malformation rate is about twice as high in white persons as among Negroes. In this series the frequency of birth of subsequent malformed offspring was twenty-five times greater in families already possessing a malformed child than in the general population.

Relation was not demonstrated between frequency of malformation and such factors as illegitimacy, economic or social status, chronic illness at the time of conception, pelvic disease prior to conception, season of the year, health of the mother or placenta previa. The older the mother, however, the more likely was she to give birth to a congenitally deformed child. The later born children in a family are more likely to be congenitally malformed than are the first born. The malformed child is less likely to go to term than the normally developed sibling. Periods of relative sterility are likely to precede the births of congenitally malformed children. In families possessing two or more malformed children, the defects in the subsequent offspring are identical with those in the previous defective in approximately 50 per cent of instances. The diets of the mothers of defective children are found to be significantly lacking in adequate amounts of calcium, viosterol, iron and vitamins B, C, and D. Altogether these investigations lead to the conclusion that gross human congenital malformations arise solely from influences which affect the germ cells prior to fertilization. Evidence available did not indicate that they result from factors that operate for the first time after fertilization has taken place. Murphy states that parents may be told that the occurrence of malformation depends on the character of the egg or sperm before fertilization rather than on any influences acting on the already fertilized egg.

1. Murphy, D. P.: Congenital Malformations, Philadelphia, University of Pennsylvania, 1939.

Book Reviews

Treatment of Fractures: By Charles Locke Scudder, M.D., F.A.C.S. Consulting Surgeon to the Massachusetts General Hospital; Formerly Assistant Professor of Surgery at the Harvard Medical School; Fellow American Surgical Association; Member of the American Society of Clinical Surgery. Price $12.00. Pp. 1208, with 1717 Illustrations. Philadelphia, W. B. Saunders Company, 1939.

This book on the treatment of fractures, in the short time it has been available to the medical profession, is rapidly becoming a classic. Kazanjian and Thoma are responsible for the chapter dealing with fractures of the facial bones. Although the subject is treated with the brevity necessitated by the character of the book, nevertheless, the material is presented with great clarity, is well illustrated, and should prove of great practical value to every dentist and oral surgeon. The subject is approached from a physiologic and anatomic standpoint.

Surgical Diseases of the Mouth and Jaws: By Earl Calvin Padgett, B.S., M.D., F. A. C. S., Associate Professor of Clinical Surgery, University of Kansas School of Medicine, Kansas City, Kansas; Associate Professor of Oral Surgery, Kansas City Western Dental College, Kansas City, Mo. 807 pages, with 334 illustrations. Cloth, $10.00 net, Philadelphia and London, W. B. Saunders Company, 1938.

This textbook has been designed to furnish a broad basis for a comprehensive approach to the subject of surgical diseases of the mouth and jaws. The modern tendency to specialization necessitates a protean knowledge on the part of the specialist in order to comprehend and practice his specialty properly. Padgett stresses the basic sciences of anatomy and pathology because, as he says, "in no other region of the entire body is it more essential to know one's way about." The fifty-two chapters comprising this book cover the field of oral surgery in a manner which leaves little to be desired.

The chapters devoted to cleft palate and harelip are excellent and furnish a modern reference on this extremely important subject. There are also chapters dealing with neoplastic diseases of the mouth, jaws, and larynx, as well as with both operative and nonoperative conditions of the salivary glands. An entire chapter is devoted to irradiation therapy in the treatment of malignant disease. The question of choice of anesthetic is also dealt with.

The illustrations although not of the atlas character which one hopes to find in a surgical text, nevertheless, help to elucidate the text in an adequate manner. A bibliography at the end of each chapter and an excellent index facilitate the use of the present volume as a reference book.

H. A. Salzmann, M.D.

Editorials

Stamps and Anesthesia

WHILE it is true that Dr. Crawford W. Long, in whose honor the Post Office Department is issuing a special stamp, appears to have performed experimental operations with ether in Georgia some two years before Dr. Horace Wells performed the authenticated experiment with nitrous oxide, Dr. Long did not mention this publicly or appreciate its humanitarian importance sufficiently to advocate its use by others.

"The Wells claim is that his successful use of an anesthetic was made known publicly at once and that he continued to use publicly and to advertise the use of the gas. Not for years after did the world at large know anything about Dr. Long's discovery. It enjoyed no benefit whatsoever from the several operations which he performed with an anesthetic prior to Wells's discovery. Dr. Long did not announce what he claimed to have done until dispute over priority arose between Wells and Dr. William T. G. Morton of Boston, who, it is clearly enough proved, knew nothing of anesthesia until Wells, confiding in him as a friend, gave information of his own success."

So says the Hartford *Times*. It is to be recalled that the Horace Wells Club was organized in Hartford, Conn., in 1894. (Incidentally an orthodontist, Dr. Fred T. Murlless, is secretary of the club at this time.) The Horace Wells Club, obviously, believes there is no reason why there should be the slightest retreat from the claim at this time that Horace Wells, on Dec. 11, 1844, discovered and demonstrated the principle of anesthesia, notwithstanding that there is to be a stamp issued commemorating the event and in memory of Dr. Long.

It is not so well known that "the Legislature of Connecticut memorialized Wells as the discoverer in 1847. It was because of that that the Paris Medical Society acknowledged Wells' work, in 1848, that the New York Medical Society, with full knowledge of all other claims, so honored him, in 1860, that the American Dental Association acknowledged his priority, 1864, that as recently as 1938 the American Dental Association, with full knowledge of all the historical evidence that has been developed in nearly a century, reaffirmed the relation of Wells to the discovery." Hartford, Conn., has a bronze statue of Horace Wells, and there is a bronze tablet on the site where his office was at the time of the discovery. In the possession of the Hartford Dental Society and in the library of the Hartford Medical Society is much interesting and valuable material accumulated since Wells' discovery.

Dr. Horace Wells should be honored for being the first to show the world that anesthesia could be employed in dental and surgical operations as well as Dr. Long for his active interest in anesthesia. Much research in tracing the record of anesthesia and its discovery by a dentist has been accomplished by Howard Raper, D.D.S., of Albuquerque, N. M., within the last few years, as well as by other dental and medical men.

The American Dental Association and Its Dues

DEFINITELY there exists a crisis in the advancement of dentistry. Its sources are from without, but they must be combated from within. A situation has arisen which demands prompt thought and immediate action. Everyone in organized dentistry should be concerned, for everyone will be affected, unless proper measures are adopted to avert disaster.

We are proud that dentistry owes its security to the fact that it has won public confidence. Public confidence and esteem are not gained by advertising, by promising, or by pretending, but only by performance. As greater knowledge and greater skill have been acquired by the profession, the quality of service rendered to the public has steadily improved, and the public confidence and respect have steadily deepened. Progress has been recognized and appreciated, and more and more it has been expected and demanded. This confidence is a complimentary tribute to dentistry, for the public is convinced by the service received that our technical procedures have underlying them a carefully reared concept of scientific principles which influence or govern procedures from their inception to their final completion. The well informed are aware that knowledge of no science is complete and that continual study is essential for those who are to be considered abreast of the times. This confidence, thus enjoyed, means security for the dental profession so long as it can be justifiably retained. If the public were not convinced that dentistry is imbued with the spirit of science, then the practitioner would become a mere artisan, and our profession would sink to the level of a trade.

All knowledge in dentistry is derived from the study and experience of the past and of the present generation. Some of it represents the work of individuals in each generation and some of it has come from group studies of each generation. Unquestionably, some brilliant contributions have been derived from individuals, but today more weight is attached to the conclusion of group workers where all findings are subjected to more analysis and fallacies are less likely to survive intelligent group inspection. Individualism has become then a somewhat discarded philosophy, and the rugged individualist will reach less ragged conclusions if his work is group work and runs the gauntlet of cooperative criticism. The idea generally prevails that by working together in cooperative groups the prospect of accomplishment is brighter. Too, our organizations of district, county, and state societies, all components of a parent organization, offer unlimited opportunity that should and does enlist the most earnest thought and endeavor of all dentists.

Some of our societies employ only conventions to present their periodic accomplishments, others add to this publications and subsidized workers, research workers, with specialists and special services available to group members. These can do for us by collective effort what no individual could perform singly; therefore, the most logical or practical avenue for our continued progress is through our professional societies, the chief of these being the American Dental Association, the smaller groups being integral with it.

The last few years have been years of international and national difficulty. All professions, professional organizations, and nearly every business has

felt the impact of troubled times. The American Dental Association has suffered likewise—this, the cornerstone of our profession, is staggering under the load of the collective services it renders in our behalf. This is not due to poor management, to lack of economy, or to inefficiency. All of these services to the profession are needed and ought to be rendered, for upon them depends the progress of dentistry, which includes the professional, financial, and social welfare of us all. This unhappy situation is brought about by conditions, world-wide in their extent, which have increased the cost and decreased the income of our indispensable Association. The most pertinent question to be asked of its membership is: "Do you care?" If you do care, quick and efficient action is necessary to re-establish and bolster the financial structure of this organization of which we are so proud, and from which we derive so much in knowledge, profit, and pleasure.

We all know that this body carries on with a membership fee of four dollars a year per member. Here is how that money is expended. From this four dollars, one dollar and thirty-nine cents pays for the *Journal of the American Dental Association,* forty-four cents goes to finance the annual convention—our greatest yearly postgraduate course. For this forty-four cents we gain the stimulus of new thought, new developments in all fields, and a new impetus for better dentistry. Let's consider, too, the value of the literature we receive, the protective and favorable legislation enacted, and the security it brings. We draw benefits continuously from this organization whether or not we have attended a meeting. The administrative salaries cost thirty-three cents, just one-tenth of the dues paid. The Association is large—there are 45,000 members, and yet for dental research, which the individual dentist cannot do for himself, there is allowed eighteen cents. For public health education, a service recognized universally as vital, there is allowed thirty-seven cents. This is pitiful, for, if we desire to hold a favorable place with other groups in the national welfare field, we should spend much more than this niggardly sum. Our Council on Dental Therapeutics and the Bureau of Chemistry draw eighteen cents. For miscellaneous and special services and for all general expenses, there remains only one dollar and eleven cents. How could one criticize the distribution of this fund?

The American Dental Association, in common with other professional organizations for the past decade, has been compelled to steadily increase the number and range of its activities. These activities render service to the public and are in keeping with the policy of other similar organizations and with the trend of the times. We should be proud that there are few in our ranks who would raise a miserly protest at an increase in dues when we well know parsimony will lead to penury. Why should an organization, representing to the fullest the progressive spirit of organized dentistry, offer to the public less than the utmost it can give? Therefore, our Association has been directed each year to spend sums ever increasing in amount. This could hardly have been evaded and our standard maintained, for each expenditure represented a new opportunity for the advancement of the profession.

Now the Association has reached the point of need. It is a crisis and it is acute, unavoidable, and inevitable. Mismanagement does not enter into

the picture. Increasing costs and broadening activities which the membership directed should be carried out have created what can be an impasse unless the situation is intelligently and sympathetically grasped and acted upon. For example, at the behest of its members, in 1938, the Association drew from its reserve fund (savings for a rainy day) the sum of $30,000, and again, in 1939, the sum of $15,000. Obviously, at this rate, the reserve found would evaporate into history.

The remedy is simple. Each member of the Association pays now less than one and one-tenth cents a day in dues. The Association dues have not advanced in ten years, although the demands upon the Association have advanced to the point of imminent disaster. If this disaster is to be averted, those who profit most from its service are quite naturally the ones to whom we must look for succor. This is the only source of revenue; therefore, an increase in membership dues is the logical step of rescue. Any other course is a backward step, an invitation to degeneration of a magnificent structure in which our minds and hearts are invested and united.

If the dues are advanced from the existing $4.00 to $6.00 it will accomplish the work of rescue. The two-dollar increase would mean in simple, childish arithmetic that we now pay one and nine one-hundredths cents a day in dues, but with the change to the six-dollar dues, the increase would be to one and sixty-four one-hundredths cents a day, or about five and one-half mills a day increase. This is not a lordly sum, to be sure, and certainly, with dentistry's century of progress just completed, none will arise to cavil and protest, for ours is a one-way highway, going forward.

O. A. O.

News and Notes

American Association of Orthodontists

The 1940 meeting of the American Association of Orthodontists will be held May 13 to 16, in Chicago, Ill. Plans are being completed rapidly for what is expected to be one of the outstanding meetings of the Association, which now has a membership that exceeds 650 members. The Chicago meeting, held in a central location, promises to have one of the largest attendances in the history of the organization.

Missouri-Kansas Dental Meeting

The Missouri-Kansas Dental Meeting will be held at the Municipal Auditorium in Kansas City, Mo., April 28 to May 1, 1940.

Cleveland Spring Clinic Meeting

The Annual Spring Clinic Meeting of the Cleveland Dental Society will be held April 8 and 9, 1940, at the Statler Hotel.

Massachusetts Dental Society

The next annual meeting of the Massachusetts Dental Society will be held at the Hotel Statler, Boston, April 22 to 25, 1940. Dr. William H. Griffin, 520 Beacon Street, Boston, is president, and Dr. Philip E. Adams, 106 Marlborough Street, Boston, is secretary.

Washington University Dental Alumni

The Washington University Dental Alumni Association will hold its annual meeting at the dental school building, 4559 Scott Avenue, in St. Louis, on April 10, 1940.

Chicago Association of Orthodontists

The annual meeting and election of officers of the Chicago Association of Orthodontists will be held Monday evening, April 29, at the Palmer House. Dr. James W. Ford, Dr. John C. McGuire, Dr. Charles R. Baker, and Dr. Frederick B. Noyes will present "Report of Cases Which Have Been Released From All Retention for a Period of Ten or More Years."

Southern Society of Orthodontists

The annual meeting of the Southern Society of Orthodontists will be held at the Roosevelt Hotel, New Orleans, April 1 and 2, 1940. The program committee has secured the following essayists and clinicians:

Dr. Spencer R. Atkinson, Pasadena, Calif.
Dr. O. V. Batson, University of Pennsylvania.
Dr. Archie B. Brusse, Denver, Colo.
Dr. W. H. Gillentine, New Orleans.
Dr. Paul Hoffman, Washington, D. C.
Dr. Neal Owens, New Orleans.

Canadian and Ontario Dental Associations

The annual convention of the Canadian Dental Association and the Ontario Dental Association will be held at the Royal York Hotel, Toronto, Ont., May 27 to 29, 1940. Dentists from the United States and all parts of Canada will be welcome.

American Board of Orthodontics

A meeting of The American Board of Orthodontics will be held at the Edgewater Beach Hotel, Chicago, Ill., Saturday, May 11, 1940.

Orthodontists who desire to qualify for certificates from the board should secure the necessary application blanks from the secretary. The applications must be returned to the secretary, together with any other required credentials, prior to the date of examination. Applications filed at the time of the board meeting will have preliminary consideration, so that the applicant may be advised of the work required for his subsequent examination.

Attention is called to the following resolutions adopted by the board: Any person desiring to make application to the board for a certificate must have been in the exclusive practice of orthodontics for a period of not less than five years or an equivalent to be determined by the board and based upon the following conditions:

1. He must be an instructor in orthodontics in a school satisfactory to the board.
2. He must be the associate in the office of an orthodontist whose standing is satisfactory to the board.
3. It is to be definitely understood that any person at the time of making application for a certificate shall be in the exclusive practice of orthodontics in his own name.

For further information, address:

Charles R. Baker, Secretary,
636 Church Street, Evanston, Ill.

Southwestern Society of Orthodontists

The nineteenth Annual Meeting of the Southwestern Society of Orthodontists was held in Houston, Texas, Feb. 18, 19, 20, and 21, at the Rice Hotel. The meeting opened on Monday with the President's address by J. H. Weaver. The following men received honorary membership in this Society: Brigadier General Leigh C. Fairbanks, Dr. Hays N. Nance, Dr. William A. Murray, and Dr. Hermann T. Becks.

The formal program of the meeting was as follows:

The Influence of the Endocrines on the Formation of the Teeth and Jaws. M. D. Levy, M.D., Houston, Texas.

Orthodontics: Its Place in Military Dentistry. Brigadier General Leigh C. Fairbanks, Washington, D. C.

The Lingual Arch Technique. Willis H. Grinnell, D.D.S., Boston, Mass.

A Model Clinic of Cases Treated With the Edgewise Appliance. Hays N. Nance, D.D.S., Los Angeles, Calif.

Fundamental Factors for Growth and Food Utilization in Relation to Orthodontics. Barnett Sure, Ph.D., Fayetteville, Ark.

The Relation of Orthodontics to the Present Social Trend. Frederick C. Elliott, D.D.S.

Notes of Interest

Dr. A. P. Westfall announces the removal of his office to Suite 310, Second National Bank Building, Houston, Texas, for the continuance of the practice of orthodontics.

Dr. Marcus D. Murphey announces the opening of his office at 2017 West Gray at Shepherd Drive, Houston, Texas, for the exclusive practice of orthodontics.

Kellogg Foundation Institute

The homecoming and dedication of the W. K. Kellogg Foundation Institute will occur at the University of Michigan School of Dentistry in Ann Arbor, April 3, 1940. The following program will be held at that time:

Dedication of the Kellogg Foundation Institute in the auditorium of the Rackham Building.

Address by Dr. Clarence O. Simpson of St. Louis on some phase of radiology.

Luncheon, followed by an address by Prof. Preston W. Slosson on the present war situation in Europe.

Unveiling of the Miller Memorial and inspection of the Kellogg Foundation Institute.

Central Association of Orthodontists

The Central Association of Orthodontists met for a luncheon and business meeting at the Stevens Hotel, Chicago, Ill., Feb. 13, 1940, at which time the following men were voted into membership in the American Association of Orthodontists and the Central Section:

E. W. Anderson, Cedar Rapids, Iowa
Earl C. Bean, St. Louis, Mo.
E. W. Bedell, St. Louis, Mo.
A. G. Brodie, Chicago, Ill.
G. L. Clinistopher, Chicago, Ill.
C. C. Cole, Rockford, Ill.
J. S. Hoffer, Des Moines, Iowa
E. V. Holestine, St. Louis, Mo.
E. E. Lampert, Chicago, Ill.
L. B. Lundergan, St. Louis, Mo.
M. J. Mayeau, Wheaton, Ill.
J. M. Pike, Minneapolis, Minn.
M. A. Ukena, Marshalltown, Iowa

OFFICERS OF ORTHODONTIC SOCIETIES*

American Association of Orthodontists

President, William A. Murray - - - - - - - - - - - - - - - - - - Evanston, Ill.
Secretary-Treasurer, Claude R. Wood - - - - - - - - - - - - - - Knoxville, Tenn.
Public Relations Bureau Director, Dwight Anderson
- - - - - - - - - - - - - - - - - - 2 East 103rd St., New York, N. Y.

Central Association of Orthodontists

President, Max E. Ernst - St. Paul, Minn.
Secretary-Treasurer, L. B. Higley - - - - - - - - - - - - - - - - Iowa City, Iowa

Great Lakes Association of Orthodontists

President, Harvey G. Bean - - - - - - - - - - - - - - - - - - - Toronto, Can.
Secretary-Treasurer, Richard E. Barnes - - - - - - - - - - - - - Cleveland, Ohio

Harvard Society of Orthodontists

President, I. D. Davis - Boston, Mass.
Secretary-Treasurer, Edward I. Silver - - - - - - - - - - - - - - Boston, Mass.

New York Society of Orthodontists

President, Franklin A. Squires - - - - - - - - - - - - - - - - White Plains, N. Y.
Secretary-Treasurer, William C. Keller - - - - - - - - - - - - - New York, N. Y.

Pacific Coast Society of Orthodontists

President, Will G. Sheffer - - - - - - - - - - - - - - - - - - San Jose, Calif.
Secretary-Treasurer, Earl F. Lussier - - - - - - - - - - - - - San Francisco, Calif.

Rocky Mountain Society of Orthodontists

President, Leonard T. Walsh - - - - - - - - - - - - - - - - - - Pueblo, Colo.
Secretary-Treasurer, George Siersma - - - - - - - - - - - - - - Denver, Colo.

Southern Society of Orthodontists

President, A. C. Broussard - - - - - - - - - - - - - - - - - - New Orleans, La.
Secretary-Treasurer, T. C. Sparks - - - - - - - - - - - - - - - Columbia, S. C.

Southwestern Society of Orthodontists

President, G. C. Turner - Lubbock, Texas
Secretary-Treasurer, R. E. Olson - - - - - - - - - - - - - - - - Wichita, Kan.

Washington-Baltimore Society of Orthodontists

President, B. E. Erikson - - - - - - - - - - - - - - - - - - - Washington, D. C.
Secretary-Treasurer, Stephen C. Hopkins - - - - - - - - - - - - Washington, D. C.

American Board of Orthodontics

President, Harry E. Kelsey - - - - - - - - - - - - - - - - - - Baltimore, Md.
Secretary, Charles R. Baker - - - - - - - - - - - - - - - - - - Evanston, Ill.
Treasurer, Bernard G. DeVries - - - - - - - - - - - - - - - - Minneapolis, Minn.
William E. Flesher - - - - - - - - - - - - - - - Oklahoma City, Okla.
Frederic T. Murlless, Jr. - - - - - - - - - - - - - - - - - Hartford, Conn.
Oliver W. White - Detroit, Mich.
James D. McCoy - Los Angeles, Calif.

Foreign Societies†

British Society for the Study of Orthodontics

President, S. A. Riddett
Secretary, R. Cutler
Treasurer, H. R. Evans

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*The Journal will make changes or additions to the above list when notified by the secretary-treasurer of the various societies. In the event societies desire more complete publication of the names of officers, this will be done upon receipt of the names from the secretary-treasurer.

†The Journal will publish the names of the president and secretary-treasurer of foreign orthodontic societies if the information is sent direct to the editor, 8022 Forsythe, St. Louis, Mo., U. S. A.